## POTASSIUM CORROSION TEST LOOP DEVELOPMENT

TOPICAL REPORT NO. 4

PURIFICATION, ANALYSIS AND HANDLING OF SODIUM

AND POTASSIUM

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#### FOREWORD

The work described herein was performed by the General Electric Company under the sponsorship of the National Aeronautics and Space Administration under Contract NAS 3-2547. The purpose was to procure, purify and analyze the alkali metals used, and to transfer the pure metals to the loops under conditions which would result in a minimum of contamination during the transfer,

Mr. L. E. Dotson and Dr. R. B. Hand, Manager, Chemistry and Physics were responsible for the equipment design and experimental work, and were assisted by Messieurs J. D. Reeves and L. A. Paian. Mr. W. R. Young, Manager, Joining and Fabrication, Messieurs P. A. Blanz and H. Mann contributed to the fabrication aspects of the program. This work was administered for the General Electric Company by Dr. J. W. Semmel, Jr., Manager, Materials and Processes. Mr. E, E. Hoffman, Manager, Corrosion Technology, acts as Program Manager of the Potassium Corrosion Test Loop Development Program and will evaluate the material performance.

Messieurs T. A. Moss and R. L. Davies were the Technical Managers for the National Aeronautics and Space Administration.

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### I. INTRODUCTION

The purpose of the Potassium Corrosion Test Loop Development Program is to develop a Prototype Corrosion Test Loop for the evaluation of refractory alloys in boiling and condensing potassium environments which simulate projected space electric power systems. The design selected consists of a two-loop Cb-lZr alloy facility in which sodium is heated by direct resistance in the primary loop and used in a heat exchanger to boil potassium in the secondary, corrosion test loop.

In order to assure that the developed test system would meet the rigorous requirements of the program, a plan was adopted which included the evaluation of as many of the Prototype Loop components and test procedures as practical in two preliminary test loop systems. The preliminary loop tests were designated as Component Evaluation Test Loops I and II. These test loops are shown in Figures 1 and 2. Liquid sodium was the test fluid in both of these loops since it was determined that the major potential problems which could be evaluated in preliminary tests were present in the primary or heater loop. In addition, this approach allowed the alkali metal handling aspects of these operations to be checked out prior to the Prototype Loop test. The purpose of this report is to describe the alkali metal purification and handling operations and the final results achieved in preparing the alkali metals for the Prototype Corrosion Loop. An isometric view of this system is shown in Figure 3.

The specific objectives of the alkali metal purification and handling phases of the Corrosion Loop Development Program were: 1) To purify the sodium and potassium for use in the three test loop systems; 2) To assure the purity of the alkali metals by analyses for oxygen and metallic impurities; and 3) To fill the test loops with the appropriate alkali metal of assured high purity.

The purification methods chosen were filtration and hot trapping for sodium; and filtration, hot trapping and distillation for potassium. reasons for the selection of these methods were as follows: Low temperature filtration was chosen to remove oxygen from both sodium and potassium down to the solubility limit of oxygen in these liquid metals at the filtration temperature (1)\*. In addition, it was reasoned that any entrained particles of 5 microns or larger would be removed from the liquid metals by filtration. Hot trapping (gettering) with titanium and/or zirconium was used to reduce the amount of oxygen remaining in the sodium and potassium after filtration. This choice was based on thermodynamic considerations (2) and work done previously in this area (3). Vacuum distillation of the potassium was performed to further remove oxygen, metallic and other stable impurities. This choice was based on the need for ultra-high purity potassium for determining corrosion effects in the Cb-1Zr Prototype Test Loop. Horsley's (4) analysis indicated that the method would be effective and prior work by SPPS had demonstrated that potassium of exceptional purity could be produced by this process.

<sup>\*(1) =</sup> Reference Number

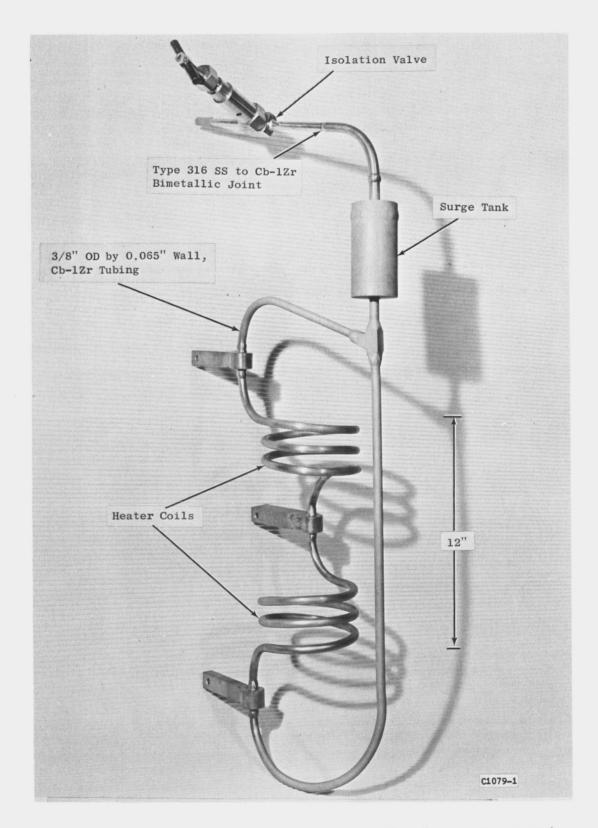


Figure 1. Component Evaluation Test Loop I. (Orig. C63121903)

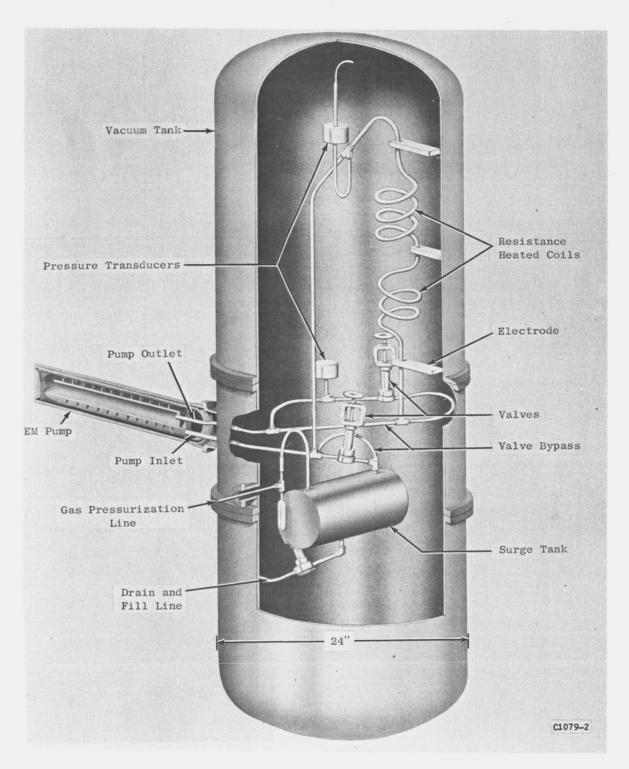


Figure 2. Isometric of Component Evaluation Test Loop II. (Orig. C64021610)

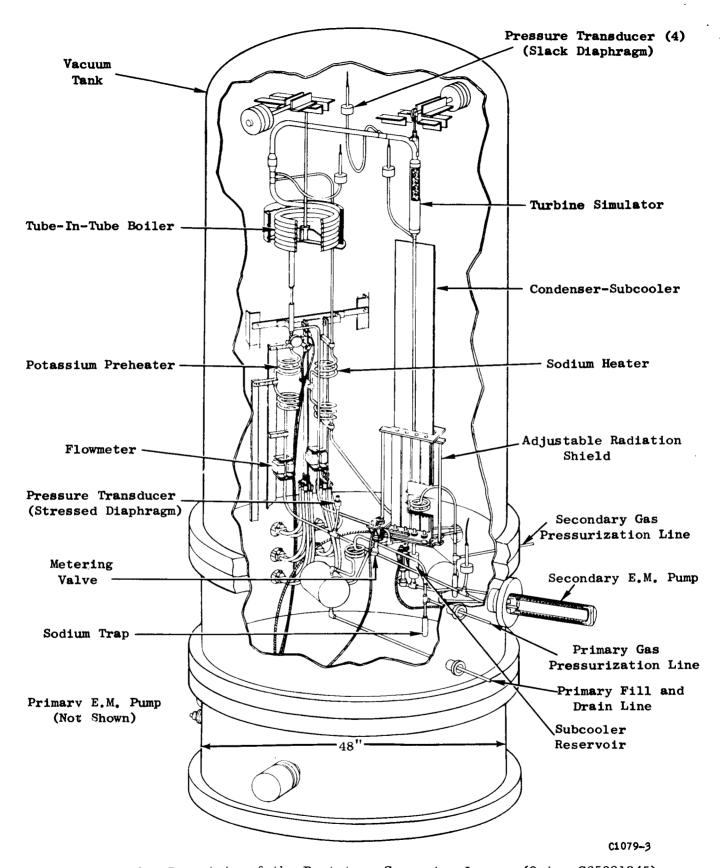


Figure 3. Isometric of the Prototype Corrosion Loop. (Orig. C65081345)

The analytical methods chosen were emission spectrographic analysis of potassium and sodium chlorides for metallic impurities and the amalgamation method for oxygen in both potassium and sodium. The emission spectrographic analytical method allows the simultaneous determinations of numerous metallic impurities in alkali metal salts, both quickly and efficiently, in the ppm range and thus was considered the best method for this purpose. Methods considered for the determination of oxygen in sodium and potassium were: the alkyl halide method (5), the bromine trifluoride method and the amalgamation method (6). The bromine trifluoride method was rejected due to its lack of development and the resulting uncertainty about its worth. The alkyl halide (amyl chloride) method was rejected since it has been proven worthless for determining oxygen in potassium in work done in this laboratory. amalgamation method, by Pepkowitz and Judd (6), was studied thoroughly in this laboratory and, after various modifications in apparatus and technique, was found to give satisfactory reproducible results for oxygen in sodium and potassium and was, therefore, judged to be the best method for the Corrosion Test Loop Program. It should be noted that serveral hundred analyses have been performed using this technique and several statistical studies have been made to establish the precision and analytical blank for the method. These studies have indicated that the standard deviation is 1.5 to 2.5 micrograms and that the analytical blank is 2 to 7 micrograms.

The alkali metal handling equipment and methods were designed to maintain all transfer systems as clean as possible during fabrication and use, and to thoroughly flush all handling systems with alkali metal before using them for sampling and filling the loops. Ultra-high purity argon was used as the cover gas.

The hot trapping apparatus in each case consisted of an austenitic, stainless steel, cylinder with flat heads, containing a titanium liner and zirconium getter operated at  $1200^{\circ}$ - $1350^{\circ}$ F under a maximum pressure of 5 psig. All filters were in-line, 5-micron nominal pore size, sintered, Type 316 stainless steel with about one square inch of filter area. The vacuum still for potassium consisted of a stainless steel pot and a Cb-1Zr alloy condenser and receiver. All transfer systems were built from Types 304 and 316 stainless steel. The nominal distillation temperature was  $600^{\circ}$ F. Transfers were made at  $50^{\circ}$ - $100^{\circ}$ F above the melting point of the respective metals.

The purification steps produced sodium and potassium with oxygen well below the requirement of 20 ppm as determined here by the amalgamation method. The metallic impurities in these metals were generally below detection limits. This high purity was maintained during the subsequent handling operations required to fill the loops. Analysis of the NaK (eutectic) used in the pressure transducers on Component Evaluation Test Loop II and the Prototype Loop indicated the same high quality found for the sodium and potassium.

All pertinent information and specifications concerning materials procurement, purification and handling methods will be found in the Potassium Corrosion Test Loop Development Topical Report No. 2. Material and Processes Specifications for Advanced Refractory Alloys. (7)

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#### II. COMPONENT EVALUATION TEST LOOP I - SODIUM

#### A. Purification System

The hot trap used to purify the sodium used in Component Evaluation Test Loop I was a typical five-pound (nominal) capacity hot trap of the type which has been used in much prior work. This type of hot trap is shown in Figure 4. All hot trap parts were Types 304 and 316 stainless steel except the titanium liner and the zirconium getter bundle. The in-line filter used in the dip leg was sintered, Type 316 stainless steel with an average pore size of 5 microns. The angle type valves were Hoke\* HY473A with the seat facing up to facilitate cleaning by procedures described in SPPS Specification No. 03-0018-00-A, Alkali Metal Handling and Control Procedures (7).

The hot trap was filled with 1437 grams of reactor grade sodium. The ratio of sodium weight to zirconium getter area was 4.7 grams per square inch. Zirconium foil with a thickness of 0.015 inch was used. The hot trap operated for 91.5 hours at 1200 to 1300°F and for 62 hours at 1300°F. The argon pressure in the hot trap was maintained at 0 to 5 psig during operation.

#### B. Alkali Metal Handling System

The handling operations involved in purifying and filling Loop I included: sampling and analyzing the sodium to be purified; filling the hot trap and analyzing the purified product; and filling the loop and analyzing the fill sodium.

A sketch of the sampling apparatus is shown in Figure 5. The sampler consists of a flush reservoir (with sufficient volume to allow thorough flushing of the sample tube), an "O"-ring sealed, Lucite viewport for estimating the flush quantity, a vacuum-argon port near the top of the reservoir for obtaining the desired atmosphere in the sampler, and a sample tube with dimensions of 1/2-inch OD x 20-mil wall by about 12 inches long which connects the sample source to the flush reservoir with Swagelok\*\*fittings. The reservoir, fittings and sample tube were made of austenitic stainless steel.

A sample was obtained, using the apparatus shown in Figure 5, by the following procedure. The sampling apparatus was degreased, pickled with 20 wt.% HCl, rinsed with water and acetone and dried at  $200^{\circ}F$  before assembly. The sampler was then assembled and attached to the sample source and the vacuum-argon manifold, after which it was evacuated to  $10^{-3}$  torr and backfilled with argon three times. The sample apparatus and source was heated to the

<sup>\*</sup>Hoke, Inc., Cresskill, New Jersey.

<sup>\*\*</sup>Crawford Fitting Company, Cleveland, Ohio.

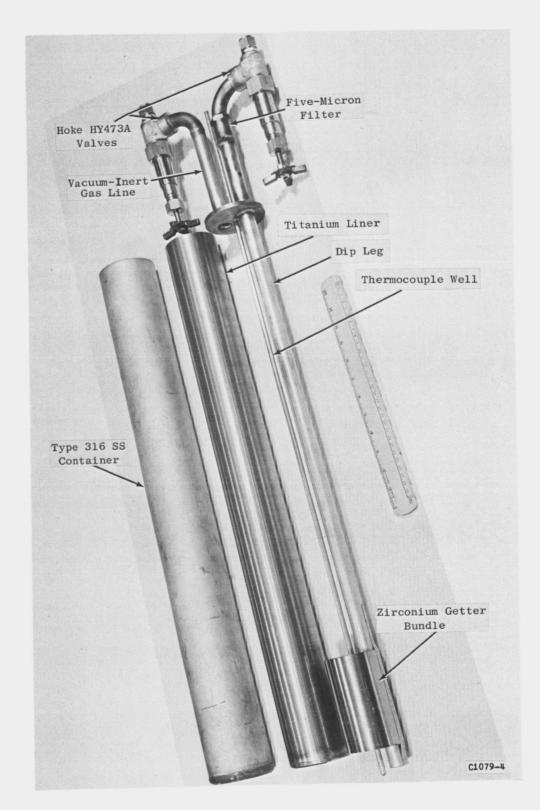
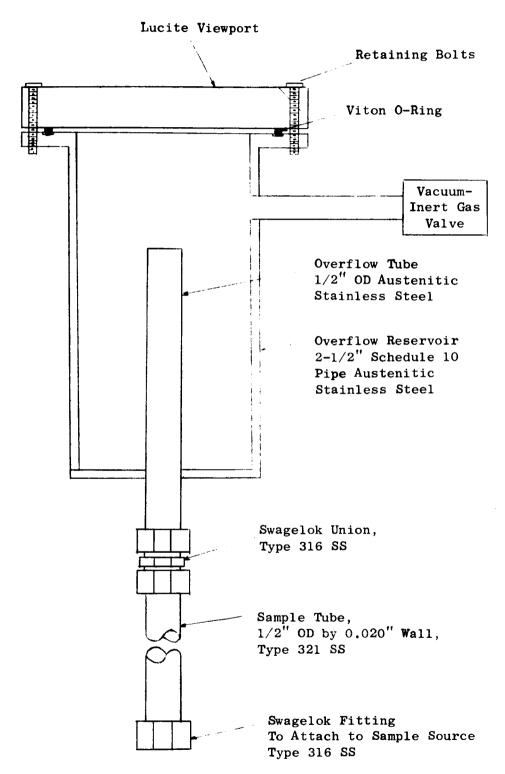


Figure 4. Five-Pound Capacity Sodium Hot Trap for Loop I.



C1079-5

Figure 5. Alkali Metal Sampling Apparatus with O-Ring Sealed Viewport.

desired temperature (50°-100°F above the melting point of the metal) with heating tapes or other appropriate devices and then the sampling apparatus was outgassed for about one hour at a vacuum manifold pressure of about 10 torr. Following the outgassing treatment, the sampler was pressurized to 1 psia with argon, and the sample was then taken by overflowing the appropriate amount into the reservoir. The sampler was pressurized to about 20 psia argon pressure and the sample was cooled. This technique was used to obtain samples from the unpurified and purified sodium (in the hot trap) used in Loop I. A different technique, however, was required and used during the actual filling of the loop and this technique will be described during the following discussion of the loop filling operation.

The sodium transfer operations, in addition to sampling, were required to provide Loop I with pure sodium. The first was the transfer of unpurified sodium into the hot trap where the purification was accomplished; and the second was the actual loop filling operation. In each case the so-called pressure change method was used to determine the quantity transferred during the transfer operation, while weight measurements before and after transfer gave the exact quantities transferred. The pressure change method is described in detail in Reference 7. The method consists of compressing or expanding a known volume of gas, under assumed isothermal conditions, from one pressure to another pressure and then calculating the volume transferred by the perfect gas law. Past use of the method has usually resulted in values within + 10 percent of the desired quantities. Since the loop filling was the only critical operation, only that transfer will be discussed here; particularly, since the method used was essentially the same as that used for filling the hot trap.

A schematic diagram of the Loop I filling and sampling system is shown in Figure 6. Referring to Figure 6, the hot trap dip leg was connected to the loop via a transfer line. This line contained the sample tube and was also attached to the vacuum-argon manifold. All connections were TIG welded except where Swagelok connectors are indicated. The entire transfer system was austenitic stainless steel with the sample tube being the same as that shown in Figure 5, except that the length was about 24 inches. The hot trap gas valve was connected to the vacuum-argon manifold to permit reading the pressure change during the filling operation. The procedure used to fill Loop I was as follows: All transfer components were heated to 250-300°F and the transfer system and loop were outgassed until the pressure rise rate was less than one micron-liter per minute. Then, knowing the required volumes, the necessary pressure decrease in the hot trap was calculated and the loop was filled by opening the hot trap dip leg valve until the desired pressure was reached. quantity of sodium desired in the loop was 114 grams; however, only 77 grams were transferred during the first fill, presumably due to gas (argon) trapped in the hot trap dip leg. A second fill added 35 grams to the original 77 making a total of 112 grams of sodium added to the loop. For the detailed procedure actually used in filling Loop I, see Appendix I.

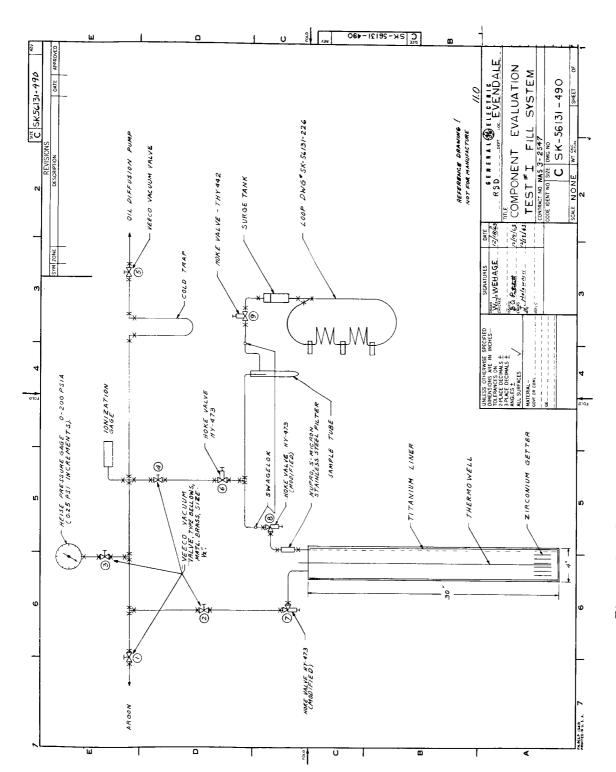


Figure 6. Component Evaluation Test Loop I Fill System.

### C. Analytical Results

The sodium used in Loop I was analyzed for oxygen before and after hot trapping and for oxygen and metallic impurities after filling the loop. The amalgamation apparatus used for the oxygen analyses is shown in Figure 7. The basic procedure used with the apparatus in Figure 7 is detailed in Reference 7 and will not be discussed here.

The results of the analyses for both oxygen and metallic impurities are presented in Table I. The oxygen values were determined by titration and calculated as monoxide. The average oxygen values shown were obtained by dividing the sum of the sample weights into the sum of the sample weight on the ppm value, where no blank is subtracted.) The hot trapping operation apparently increased the original oxygen content of the sodium used; however, this difference, about 6 ppm, could be due to experimental error. The higher oxygen values obtained on the loop fill samples were probably, in part at least, due to contamination by the transfer system welds. However, the sodium which went into the loop probably contained less than 20 ppm oxygen since the analytical blank, which usually ranges from 2 to 7  $\mu$  gms, was not subtracted from the values shown in Table I.

The specification of allowable impurity concentrations in the sodium metal is also shown in Table I. As shown, the metallic impurities in the first sodium fill sample were at, or well within, the allowable concentrations. The weighted average oxygen value of 20.8 ppm for the two fill samples includes the analytical blank (2 to 7  $\mu$ gms oxygen) and thus meets the specification.

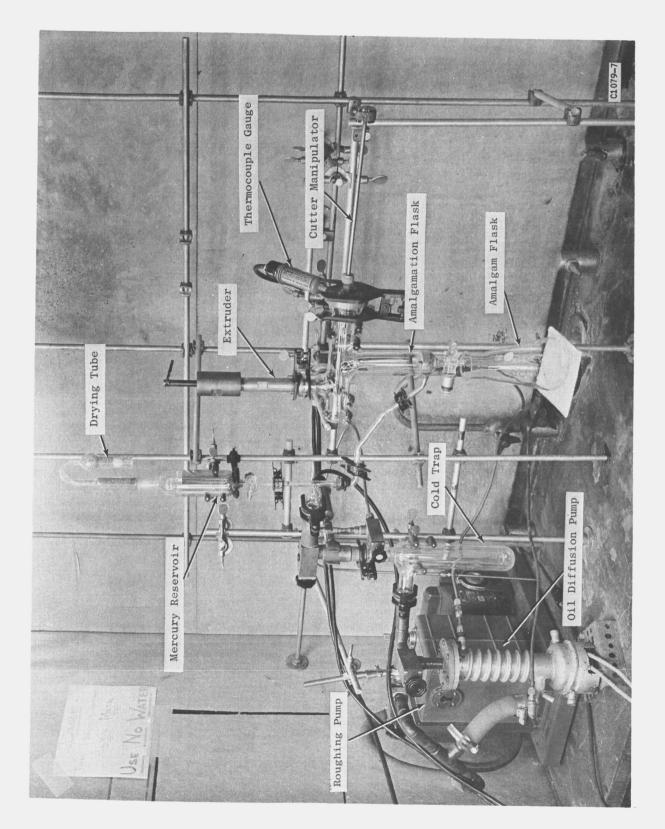


Figure 7. Amalgamation Apparatus for Oxygen in Sodium Component Evaluation Test Loop I. (Orig. C63120203)

TABLE I. ANALYSES OF SODIUM FOR COMPONENT EVALUATION TEST LOOP I

| Sample (4) Oxygen (2)              |          | Sodium before hot trapping 2.0 6.6 6.6<br>Container No. 3E, No. 85 | After hot trapping 91.5 1.812 10.1 hrs. (§ 1200°-1300°F 1.500 9.7 Sodium from Container 1.258 14.3 12.8 No. 3E, No. 86 2.385 15.9 | Sodium sample from first 1.782 18.4<br>loop fill, 0.669 39.5 18.5 -<br>No. 120 0.892 15.6 | Sodium sample from 1.826 26.1 second loop fill, 0.621 25.0 23.4 No. 121 18.6 | Sodium sample from hot     1.833     10.8       trap after second loop     1.207     10.6     12.9       fill, No. 122     0.589     23.7 | Sodium purity requirements |
|------------------------------------|----------|--|---|---|--|---|----------------------------|
|                                    | Fe       |  |   | /   |  |   | 25                         |
|                                    | В        |  |   | <3 <13  |  |   | 65                         |
|                                    | ဒ        |  |   | <13   |  |   | 22                         |
|                                    | W        |  |   | 8   |  |   | 25                         |
|                                    | Be       |  |   | <b>€</b>  |  |   | 25                         |
|                                    | A1       |  |   | ro<br>V   |  |   | 25                         |
|                                    | Mg       |  |   | 33  |  |   | 25                         |
|                                    | Zu       |  |   | <125 <  |  |   | 125                        |
|                                    | Sn       |  |   | <13 <   |  |   | 25                         |
| i mad                              | Co       |  |   | 8   |  |   | 25                         |
| n Alk                              | <u>ଥ</u> |  |   | ×<br>×  |  |   | 25 2                       |
| ali Me                             | Cr Si    |  |   | <3 <25  |  |   | 25 6                       |
| ppm in Alkali Metal <sup>(1)</sup> | <u>=</u> |  |   | 25 <13  |  |   | 65 2                       |
|                                    | Ni<br>Ni |  |   | 13 <3   |  |   | 25 25                      |
|                                    | i Mo     |  |   | 3 <13   |  |   |                            |
|                                    | >        |  |   | ب<br>د<br>د   |  |   | 25 40                      |
|                                    | AB       |  |   | ъ<br>го   |  |   | 0 25                       |
|                                    | Zr       |  |   | < 25  |  |   | 25                         |
|                                    | Sr       |  |   | × 3   |  |   | 5 25                       |
|                                    | Ba       |  |   | 9>  |  |   | 25                         |
|                                    | Ca       |  |   | က   |  |   | 25                         |
|                                    | ×        |  |   | 250   |  |   | 200                        |

(1) Analyses for metallic impurities performed by Nuclear Materials and Equipment Corp., Apollo, Pa.

(2) Oxygen calculated as monoxide by titration - avg. ppm = total  $\mathcal{H}$ gms. divided by total sample weights.

(3) Average oxygen content of sodium added to loop without subtracting analytical blank.

(4) Analytical blank, 5-10 µgms oxygen per sample, not subtracted.

## III. COMPONENT EVALUATION TEST LOOP II - SODIUM

### A. Purification System

Reactor grade sodium was purchased from U. S. Industrial Chemicals (USI) for use in Component Evaluation Test Loop II and the Prototype Corrosion Loop. The 100 pounds of sodium was received in two 50-pound capacity shipping containers which were fabricated at General Electric. A sketch of one of these containers is shown in Figure 8. The body was constructed of welded, 10-inch schedule 10 pipe with 1/4-inch thick, flat, end caps. Both the gas line and the dip leg were 1/2-inch, schedule 10 pipe. The thermocouple well was 1/4-inch OD x 1/8-inch ID tubing. The valves were cleanable, right angle pattern, Hoke Type HY473 or HY473A. All materials were austenitic stainless steel. All welding was by tungsten inert-gas arc with inert back-up gas. The containers were helium leak checked prior to shipment to USI for filling with sodium.

A 15-pound capacity sodium hot trap was designed and fabricated for use in purifying sodium for Loop II and the Prototype Loop, Figure 9 shows an exploded view of this unit. The 15-pound hot trap contained the same components as the previously described 5-pound hot trap of Figure 4 except that the 15-pound hot trap was equipped with a charge pot of known volume for adding the desired amount of sodium to the Loop II surge tank. The ratio of the quantity of sodium to the zirconium area was 2.7 grams/inch<sup>2</sup>, maximum. The vacuum-argon manifold used for the 15-pound sodium hot trap was the same as that shown in Figure 5. The hot trap was outgassed at 400°-600°F for about 100 hours until the vacuum system pressure was less than 10-6 torr. A quantity of sodium weighing 12.8 pounds was added to the hot trap and gettered for 100 hours at 1300°-1400°F.

### B. Alkali Metal Handling System

The filling, sampling and analyzing operations required to produce pure sodium in the 15-pound hot trap were the same as those used on the 5-pound hot trap for Loop I - the exceptions being the source of sodium and the hot trap size. An additional problem encountered in Loop II was the sampling and analysis of eutectic NaK.

Eutectic NaK was used in the Loop II pressure transducers. The NaK filled transducers were supplied by the Taylor Instrument Company, Rochester, New York During each transducer filling operation a NaK sample was obtained to be analyzed for oxygen and metallic impurities. The NaK sampling apparatus is shown in Figure 10. The sampler consisted of a capillary fill tube, an expansion coil to compensate for temperature changes, a sample section composed of 1/2-inch schedule 40 pipe and a right angle, cleanable, valve through which the sample was introduced into the analytical apparatus via Swagelok and "O"-ring joints. All sampler parts were austenitic stainless steel. All sampler joints were TIG welded.

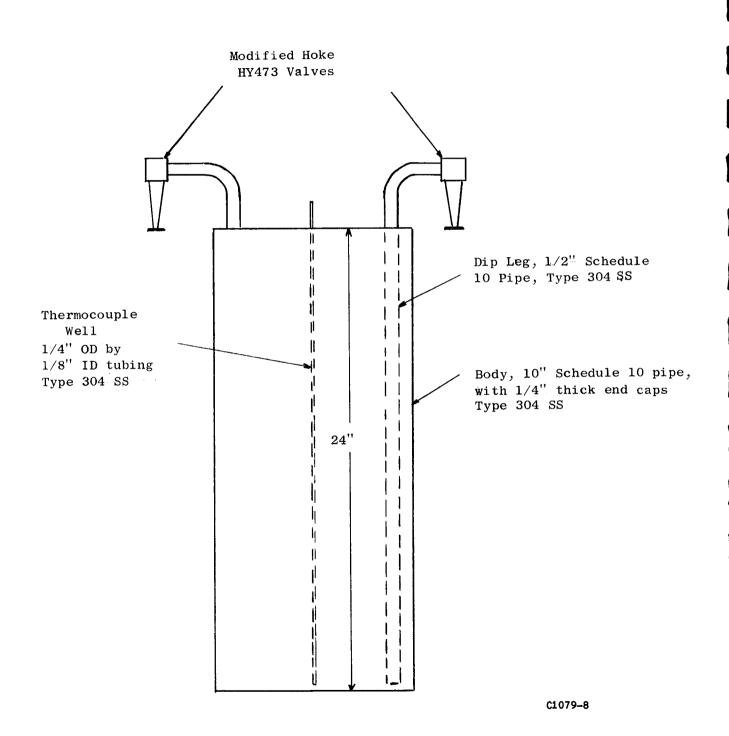


Figure 8. Fifty-Pound Capacity Sodium Shipping Container,

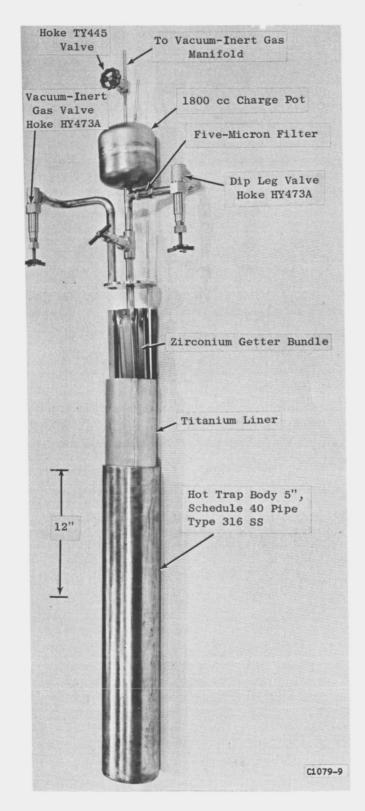


Figure 9. Fifteen-Pound Capacity Sodium Hot Trap with Charge Pot. (Orig. C64041327)

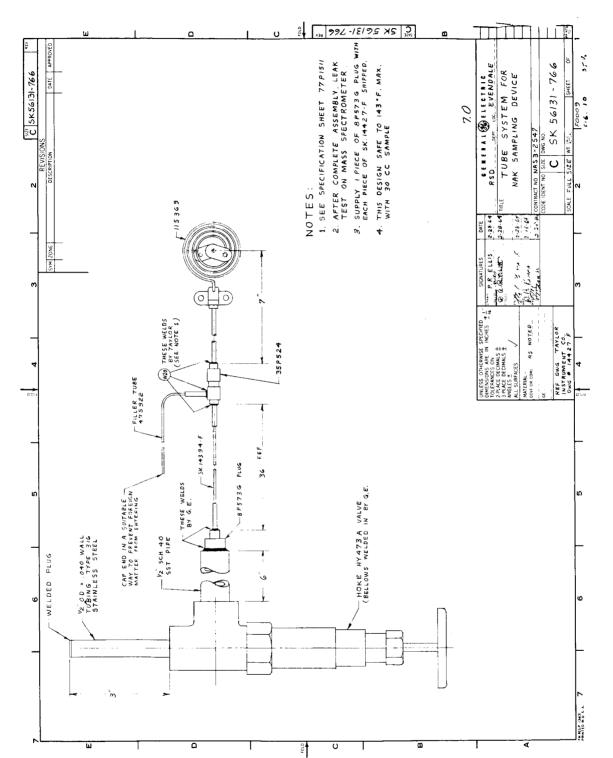


Figure 10. Tube System for NaK Sampling Device.

The transfer of the sodium from the 15-pound hot trap into Loop II involved a more complex system than that used for Loop I. The apparatus used consisted of a purification system dolly which was portable and a stationary transfer - sampling - disposal system which was connected directly to the loop. Figure 11 shows a schematic diagram of the components of the loop fill system. The vacuum-argon manifold and the hot trap were enclosed in a portable dolly with an oven where the hot trap was located. The transfer section of the fill system contained a by-pass sampling section, a disposal tank, the necessary transfer lines and an oven heater; and was entirely enclosed by insulated walls, making an oven of the entire section enclosure. Figures 12 and 13 show the hot trap dolly and transfer sections, respectively, prior to the filling operation. All items which contacted sodium were austenitic stainless steel. All connections were TIG welded except, referring to Figure 11, between valves L and S, valves D and E and valves I and J, where Conoseal\* tube unions were used.

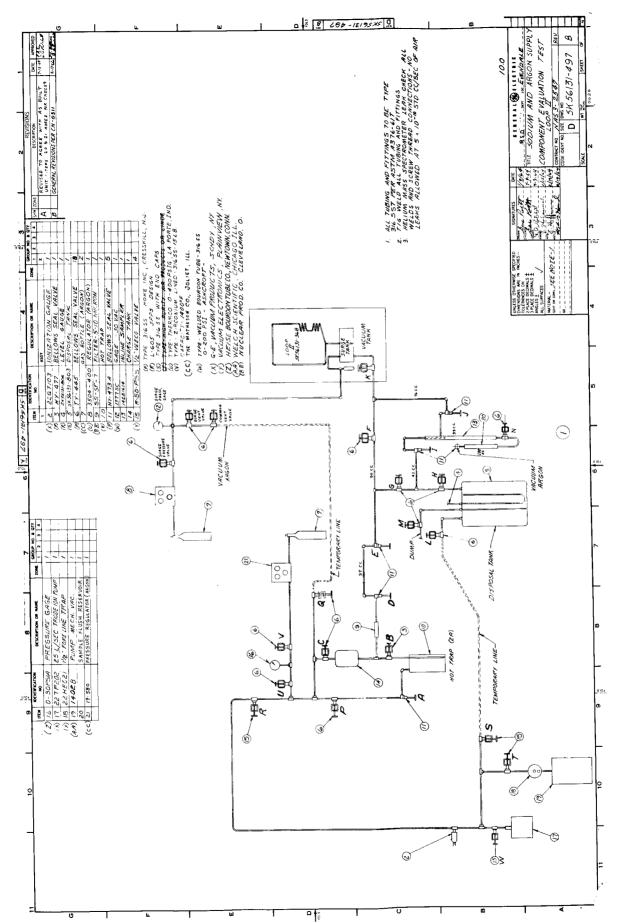
Using Figure 11 as a guide, the general loop filling procedure was as follows. The sub-operations in the procedure included: Installation of the sampler in the transfer section; connecting the sodium and vacuum-argon lines between the purification dolly and transfer section; helium leak checking the entire filling system cold; outgassing the transfer system at  $250^{\circ}-350^{\circ}F$  until the pressure rise rate was 0.95 micron-liters per minute and helium leak-checking it hot; flushing the transfer system with sodium, then sampling and analyzing; filling and flushing the loop with sodium, then again sampling and analyzing.

The sampler was installed, the purification dolly was attached to the transfer section and helium leak checking revealed no leaks at a sensitivity of 5 x  $10^{-11}$  std. cc of air per second. The fill system was heated to  $250^{\circ}-$ 350°F, and outgassed and helium leak checked to meet the previously stated The charge pot was filled with sodium and about one pound was flushed through the transfer section into the disposal tank with the sampler Then another pound of sodium was flushed through the sampler into isolated. the disposal tank. The sample was removed and analyzed for oxygen and found to contain less than 20 ppm. The charge pot was then refilled and emptied into the loop surge tank. The loop was flushed by circulating the sodium at 500°F for one hour, after which the loop was dumped into the surge tank and the sodium was sampled into a new sampler installed between valves I and J in the transfer section. Subsequent analysis of the loop flush sample indicated that sodium was of the high purity needed for loop operation. A more detailed procedure is presented in Appendix II.

### C. Analytical Results

The apparatus used for determining oxygen in the sodium and NaK by the amalgamation method is shown in Figure 14. This apparatus was equipped with a vacuum system capable of blank-off pressures of less than  $10^{-7}$  torr and a high purity helium or argon source. Solid samples were extruded and dropped into the reaction section using a hot wire cutter. Eutectic NaK or other

<sup>\*</sup>Aeroquip Corporation, Marman Division, Los Angeles, California.



Sodium and Argon Supply for Component Evaluation Test Loop II. Figure 11.

Vacuum-Inert Gas Manifold Oven Thermocouple Well Charge Pot Hoke HY 473A Valve Five-Micron Filter Sodium Transfer Line Hoke HY473A Valve Hot Trap Right Angle Drive

Figure 12. Loop II Purification System. (Orig. C64061828)

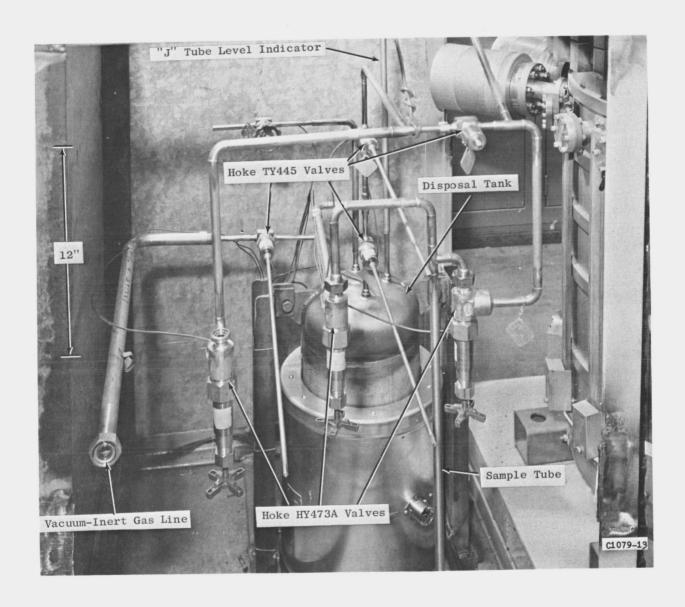


Figure 13. Loop II Transfer System. (Orig. C64061825)

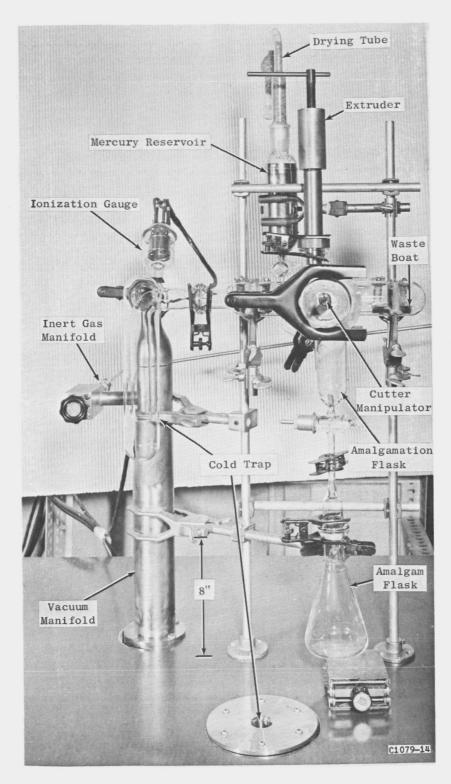


Figure 14. Amalgamation Apparatus for Determining Oxygen in Loop II Sodium and NaK. (Orig. C64041574)

liquid samples were introduced through cleanable, "O"-ring sealed adapters. The basic difference between the apparatus in Figure 14 and that shown in Figure 7 is that the sliding seal cutter shown in Figure 7 had been replaced by a welded, stainless steel, bellows-sealed cutter. The analytical results for oxygen and metallic impurities in the Loop II sodium and NaK are shown in Table II, as are the purity specifications for sodium.

The as-received sodium had a rather high average oxygen concentration and some of the metallic concentrations were higher than expected. Following hot trapping and all subsequent handling of the Loop II sodium, the oxygen concentrations of the various samples were quite low as were, in general, concentrations of the metallic impurities. In both cases, the impurity concentrations were lower than specified. Thus, Loop II was provided with sodium of high purity according to available analytical techniques.

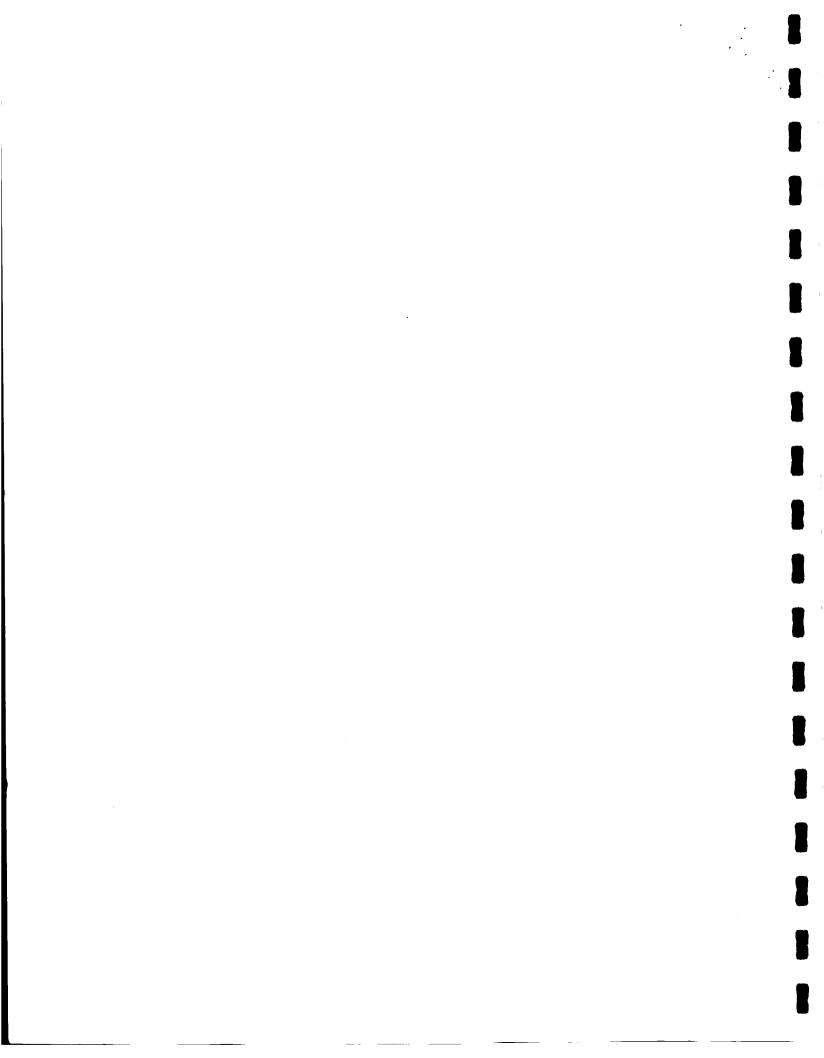
The NaK sample obtained by Taylor during the filling of the Loop II pressure transducer was not taken in the prescribed manner. This resulted in the loss of a large portion of the sample in preparing the sampler for analysis. Therefore, the NaK quantity available was sufficient only for one oxygen analysis. As shown in Table II, the oxygen content (5.1 ppm) of the NaK was quite low.

TABLE II. ANALYTICAL RESULTS FOR SODIUM AND NAK USED IN COMPONENT EVALUATION TEST LOOP II

| em 1.587<br>0.844<br>40 1.587<br>0.630<br>0.630<br>143 2.080<br>1 978<br>1 978<br>1 978<br>2 455<br>1 914<br>1 3.210                                     | Sample   | Sample                  | Oxygen,              | Oxygen, (2) Oxygen, |    |      |      |          |        |          |        |        |          | dd     | m in,         | ppm in Alkali Metal | Metal |               |     |    |  | !  |   |   |   |
|--|--|-------------------------|----------------------|---------------------|----|------|------|----------|--------|----------|--------|--------|----------|--------|---------------|---------------------|-------|---------------|-----|----|--|----|---|---|---|
| 40 1.884 99.5 41.1 10 4.13 4.3 4.0 3 7125 713 5 13 5 13 5 13 73 73 73 73 73 73 73 73 75 75 75 75 75 75 75 75 75 75 75 75 75                              | Identity   | gms.                    | шdd                  | mdd                 | 된  | m    | ဒါ   | Mn       |        | Mg       | Zn     | Sn     | Cr       | Pb     | Cr            | Si                  | Ţ     | Ni            | Mo  |    |  | Zr |   |   |   |
| 2.080 7.5 8.9 3 13 13 3 3 13 (125 7125 713 63 63 65 25 25 25 25 25 25 85 8 25 8 25 8 25  | Sodium as received<br>Container No. 1, No. 140                                     | 0.844<br>1.587<br>0.630 | 99.5<br>11.6<br>37.3 | 41.1                | 10 | <13  | < 13 | <b>m</b> | 40     | ю        | <125   | <13    | ū        | 113    | တ             | . 25                | < 13  | ,<br>,        | .13 |    |  |    | • |   |   |
| 1.978 6.9 7.9 2.01 5.4 2.004 11.7 2.004 11.7 2.004 11.7 3 8 3 <125 <13 <3 <13 <3 <13 <3 <13 <3 <13 <3 <3 <3 <3 <3 <4 <4 <4 <4 <4 <4 <4 <4 <4 <4 <4 <4 <4 | Sodium after hot trapping<br>100 hours at 1300°-1370°F<br>Container No. 1, No. 143 | 2.080<br>1.676<br>1.318 | 7.5<br>9.6<br>10.1   | 6.8                 | ო  | . 13 | 13   | ы        | m      | <b>6</b> | <125   | 13     | ო<br>\   | <13    | <b>ო</b><br>∨ | 25                  | <13   | ო<br>∨        | 13  | e  |  |    |   | œ | 0 |
| 2.455 4.3 5.9 3 13 13 3 8 3 <125 <13 <3 <13 <3 <13 <3 <13 <3 <3 <3 <3 <3 <3 <3 <3 <3 <3 <3 <4 <8   | Loop II transfer system<br>flush sample, No. 151                                   | 1.978<br>3.211<br>2.604 | 6.9<br>5.4<br>11.7   | 7.9                 |    |      |      |          |        |          |        |        |          |        |               |                     |       |               |     |    |  |    |   |   |   |
| 3.210 5.1 5.1 Insufficient NaK quantity for spectrographic analysis  20 25 65 25 25 25 25 25 25 25 25 25 55 65 25 25 40 25 25 25 25 25 50                | Loop II fill sample,<br>No. 152  | 2.455<br>1.914<br>1.317 | 4.3<br>6.9<br>7.4    | 5.9                 | т  | 13   | 13   | က        | œ      |          | <125   | <13    | <b>m</b> | <13    | <b>8</b> ∨    | < 25                | <13   | <b>ღ</b><br>∀ | <13 | 3  |  |    |   |   | 0 |
| 20 $25$ $65$ $25$ $25$ $25$ $25$ $25$ $25$ $25$ $2$  | NaK used in Loop II<br>pressure transducers,<br>No. 138                            | 3.210                   | 5.1                  | 5.1                 |    |      | Ins  | uffic    | ient N | aK gua   | intity | for si | pectro   | graphi | ic ana        | lysis               |       |               |     |    |  |    |   |   |   |
|  | Sodium and NaK purity requirements   |                         |                      | 20                  | 25 | 65   | 25   | 25       | 25     | 25       | 125    | 25     | 25       | 25     | 25            | 65                  | 25    | 25            | 40  | 25 |  |    |   |   |   |

(1) Oxygen calculated as monoxide by titration - avg. ppm = total  $\mu$ gms divided by total sample weights.

(2) Analytical blank, 5-10 µgms oxygen per sample, not subtracted.



## IV. PROTOTYPE CORROSION LOOP - POTASSIUM AND SODIUM

#### A. Purification

Two hundred pounds of high purity potassium were purchased to SPPS Specification No. 01-0039-00-B (7) from Mine Safety Appliances Research Corporation, Callery, Pennsylvania for use in the Prototype Loop and subsequent corrosion loops using potassium. Although this lot of potassium was very pure, according to both the vendor and our quantitative analyses, it was nevertheless processed by filtration, hot trapping and vacuum distillation.

As stated previously, all filtration operations were accomplished through in-line filters composed of sintered, Type 316 stainless steel with a 5-micron average pore size. Filtration was performed after hot trapping and again after distillation.

The hot trapping was done in a titanium lined, zirconium gettered system, in this case, of 50-pound capacity. A view of the 50-pound capacity hot trap components is shown in Figure 15, prior to final assembly, and assembled in Figure 16. The angle pattern valves were Hoke HY473A (cleanable), the auxiliary gas valve is a Hoke TY445. The 1/4-inch OD thermocouple well and the 1/2-inch tube extending into the hot trap are for temperature and level measurement. All parts, except the gettering materials, were austenitic stainless steel. The getter bundle was formed from concentric cylinders spaced 1/2-inch apart, The ratio of potassium quantity to getter bundle was 5,5 gms/inch<sup>2</sup>, excluding the liner surface.

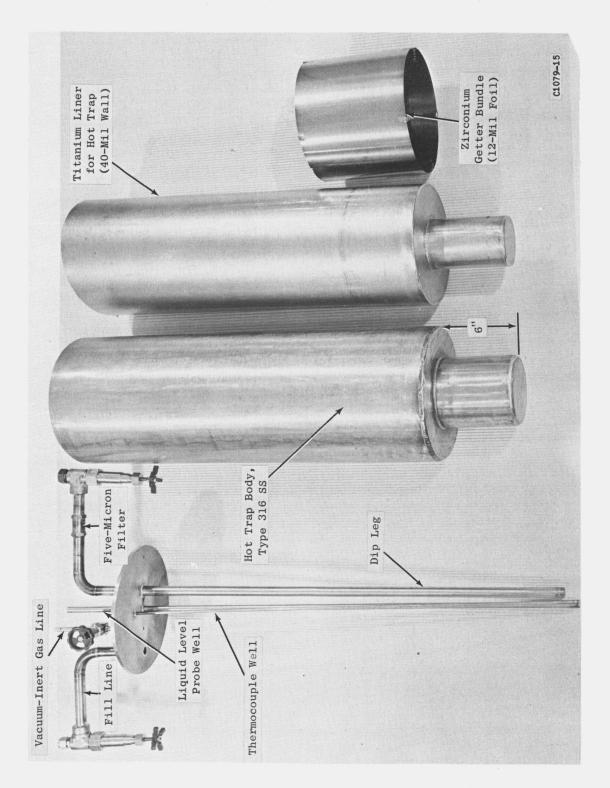
The hot trap was loaded with 46.5 pounds of potassium as determined by direct weight measurement. The gettering operation was carried out at  $1250^{\circ}-1300^{\circ}F$  for 50 hours. After hot trapping, the potassium was outgassed at  $350^{\circ}-465^{\circ}F$  for about two hours to remove any hydrogen present.

Before the distillation operation was carried out, the hot trap, the vacuum-argon system and the still were assembled together on a portable dolly. The assembly is best shown by the schematic diagram in Figure 17 since it was impossible to photograph the assembly to show all the components adequately.

The vacuum-argon system consisted of an argon supply section and a high vacuum system which could be attached to both the still and the hot trap.

Matheson\*, ultra-high purity grade, argon was used. Viton "O"-ring sealed, bellows type, stainless steel valves were used in the argon section. All connecting piping was austenitic stainless steel and connections were TIG welded except for the pressure gauge and the thermocouple gauge threaded connections, where teflon tape was used as the sealant.

<sup>\*</sup>Matheson Company, East Rutherford, New Jersey.



Potassium Hot Trap for the Prototype Corrosion Loop Prior (Orig. C65021019) to Assembly. Figure 15.

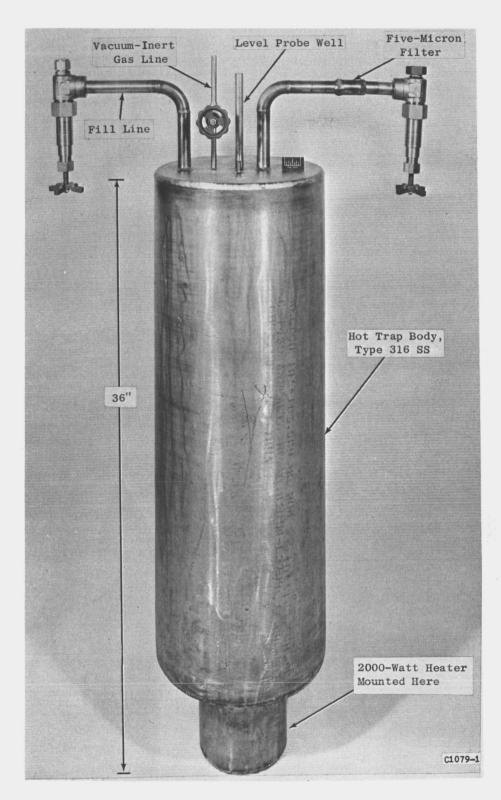
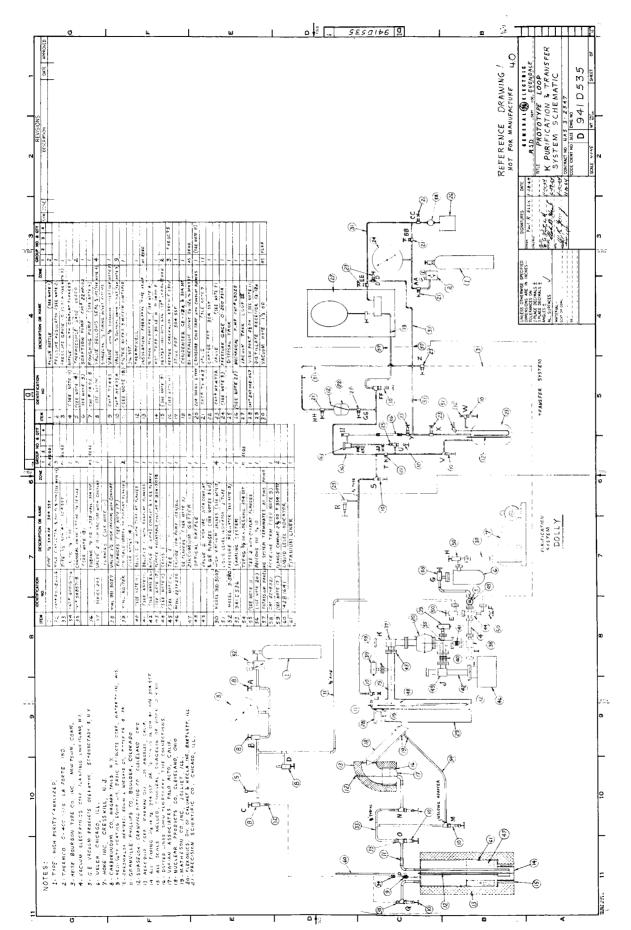


Figure 16. Hot Trap for Purifying Potassium for the Prototype Corrosion Loop. (Orig. C65021030)



Prototype Corrosion Loop Potassium Purification and Transfer System Schematic. Figure 17.

The high vacuum system had a General Electric, Model 22TP250, 100 1/sec, triode, getter-ion pump, backed by a cryogenic pump and a mechanical roughing pump. Ultra-high vacuum valves (welded, stainless steel, bellows type with OFHC copper seats), and high vacuum valves (plate type welded bellows and viton seals) were used. Bellows were placed in strategic locations to reduce stresses on the connecting flanges. All connections between the high vacuum system components were made with OFHC copper gasketed Conflat\* flanges.

The potassium still consisted of a stainless steel boiler, a Cb-IZr condenser and a Cb-IZr condensate receiver. The boiler section was heated circumferentially by hand heaters to promote surface evaporation. The condenser was a coaxial type, containing an inner Cb-IZr tube such that all condensate which entered the receiver contacted only Cb-IZr. Figure 18 shows the condenser inlet with the inner Cb-IZr tube protruding from the stainless steel pipe. The outer stainless steel tube of the condenser was attached to the Cb-IZr tube by a brazed joint. Copper cooling coils were wound on and brazed to the stainless steel condenser pipe. During distillation, the annular space between the tubes was filled with potassium which acted as the heat transfer medium for rejecting the heat of condensation. The receiver was equipped with a viewport, thermocouple well and dip leg. The dip leg was attached to a stainless steel filter and a Hoke HY473A cleanable valve. A view of the still prior to assembly is shown in Figure 19 and after assembly in Figure 20.

After assembling the Prototype Loop potassium purification system on the portable dolly, the high vacuum system and the still were baked out and the distillation operation was carried out.

The high vacuum system was covered with a portable oven and baked out at about 200°F for 94 hours until the pressure rise rate measured at room temperature was 0.9 micron-liter per hour.

The still was baked out for two weeks with boiler temperatures ranging from  $500^{\circ}$  to  $800^{\circ}$ F, condenser temperatures ranging from  $300^{\circ}$  to  $550^{\circ}$ F, and receiver temperatures ranging from  $250^{\circ}$  to  $350^{\circ}$ F. The ultimate low pressure obtained in the still was  $3.9 \times 10^{-8}$  torr with a pressure rise rate of 0.4 micron-liter per hour at room temperature.

The distillation was carried out at 500° to 600°F. The condenser temperature was maintained at 250° to 350°F with an air flow rate through the cooling coil of one pound/hour. The receiver was held at or below the melting point of potassium. About 27.5 pounds of potassium were distilled at an average rate of one pound per hour. The resulting distillate was sampled and analyzed by the methods used on the Loop II sodium.

The Loop II sodium purification system was used to purify the

<sup>\*</sup> Varian Associates, Palo Alto, California

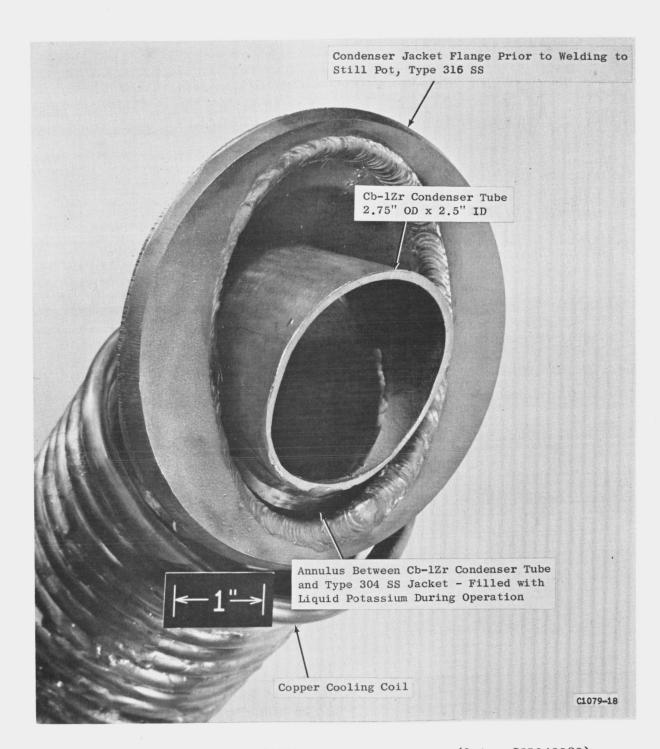
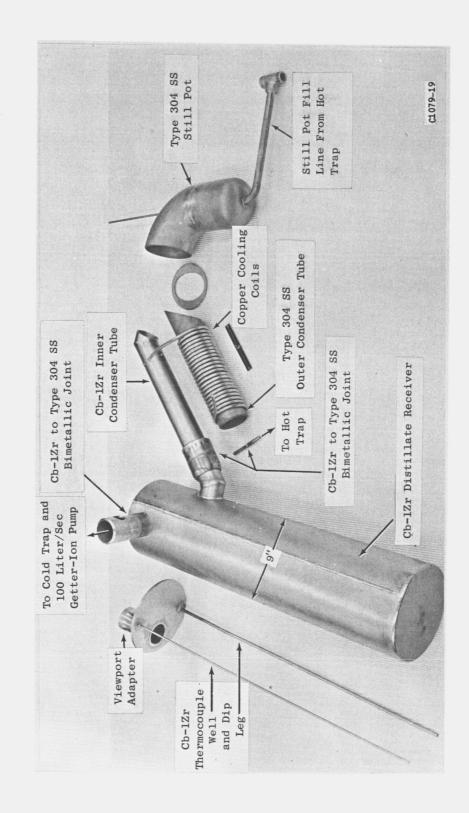


Figure 18. Potassium Still Condenser Inlet. (Orig. C65040929)



Components for Prototype Loop Potassium Still. (Orig. C65062186) Figure 19.

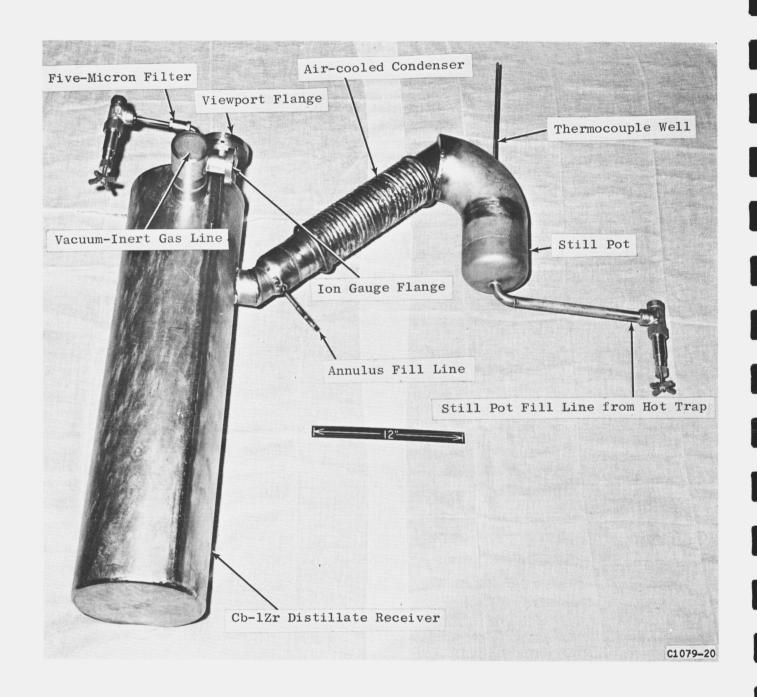


Figure 20. Potassium Distillation Unit After Assembly. (Orig. C65041404)

Prototype Loop sodium after installing the apparatus in a permanent dolly. Figures 21 and 22 show the hot trap and vacuum-argon control panel in the permanent dolly respectively. The hot trap was again filled to near its 15-pound capacity. Gettering was performed at  $1275^{\circ}-1375^{\circ}F$  for 120 hours. Sampling and analysis were performed as described previously for the Loop II sodium.

### B. Alkali Metal Handling System

Since the Prototype Loop System is a two-loop system, a dual transfer system was required for dispensing the sodium and potassium to the separate loops from the purification systems. Figure 23 shows a side view of the dual transfer system with one of the side panels of the oven removed. Figure 24 shows, schematically, the arrangement of the components of the transfer system for the potassium and sodium sides. As shown in Figure 23, each transfer system contained a charge pot of known volume, a disposal tank, a sampling valve and the necessary transfer and vacuum-argon lines. The purification systems were attached to the transfer system as shown in Figure 24 by the usual TIG welding techniques. The spatial arrangement of the entire system hook up is shown in Figure 25, including the high vacuum sampler. After connection, the entire dual transfer system was helium leak checked both hot  $(250^{\circ}$  to  $350^{\circ}$ F) and at room temperature and found to be leak tight at a sensitivity of 5 x  $10^{-11}$  std cc per second of air.

The transfer systems were baked out at  $250^{\circ}$  to  $350^{\circ}$ F for about one week until the pressure rise rate on the sodium side was 0.3 micron-liter per minute and that on the potassium side was 0.9 micron-liter per minute.

The procedure followed in filling the loops for the Prototype Loop System was the same for each loop and almost identical to that used for Loop II. Referring to Figure 24, a brief description of the procedure is as follows. The transfer lines between the alkali metal source, the disposal tank, the loop and the charge pot were evacuated and then filled with alkali metal. Then about three pounds of metal were drained from the charge pot into the disposal tank using the pressure change method previously described. The charge pot was then refilled and a flush sample was taken for analysis.

The sampler used in this case was of the same type previously shown, but was designed for high vacuum use and is shown in Figure 26.

The oxygen content of the flush sample was less than 20 ppm, so the charge pot was refilled and its contents transferred into the loop surge tank. The loop was then flushed for at least an hour at  $500^{\circ}$  to  $700^{\circ}$ F, after which the loop was dumped and a surge tank flush sample

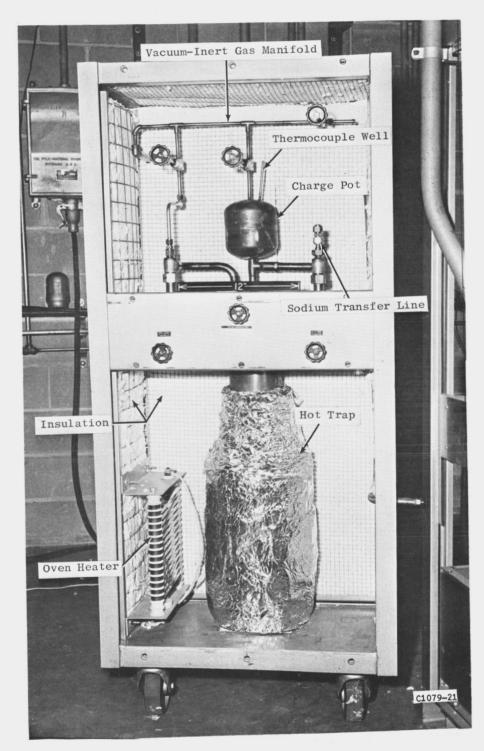


Figure 21. Sodium Purification System Showing Hot Trap, Charge Tank, and Oven. (Orig. C65041402)

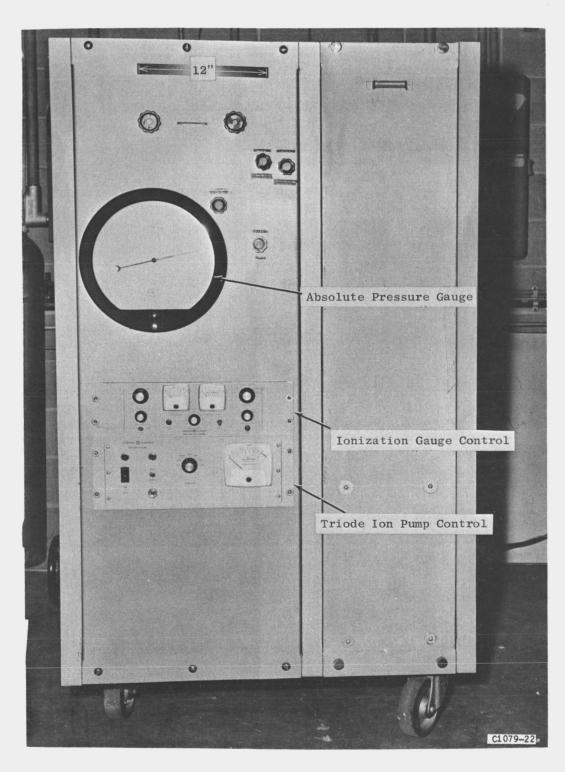


Figure 22. Control Panel of Sodium Purification System - Prototype Loop. (Orig. C65041401)

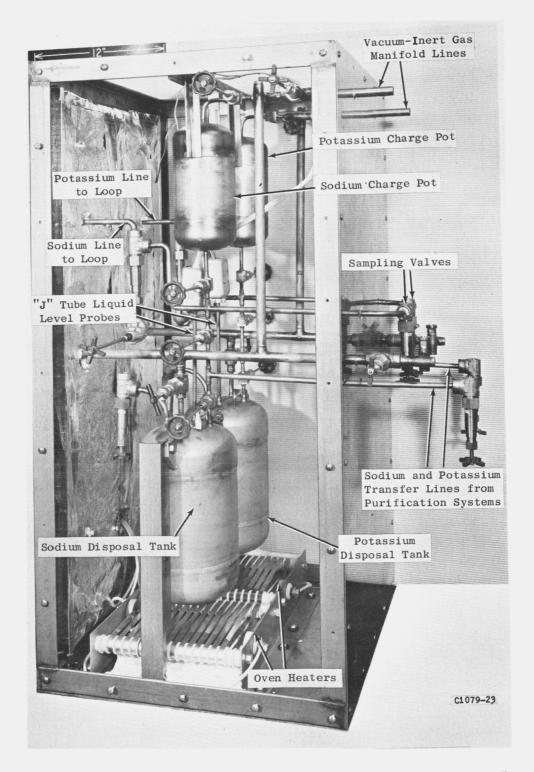
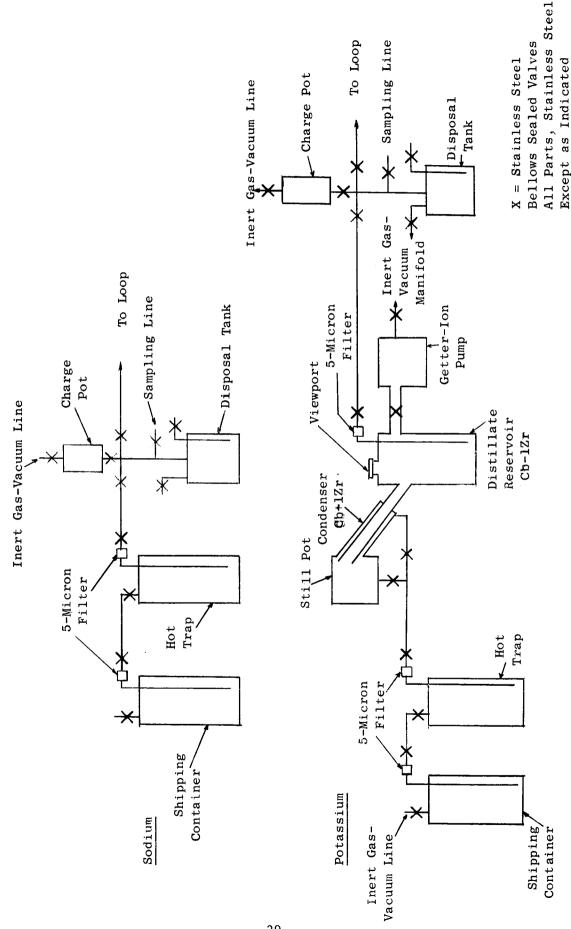


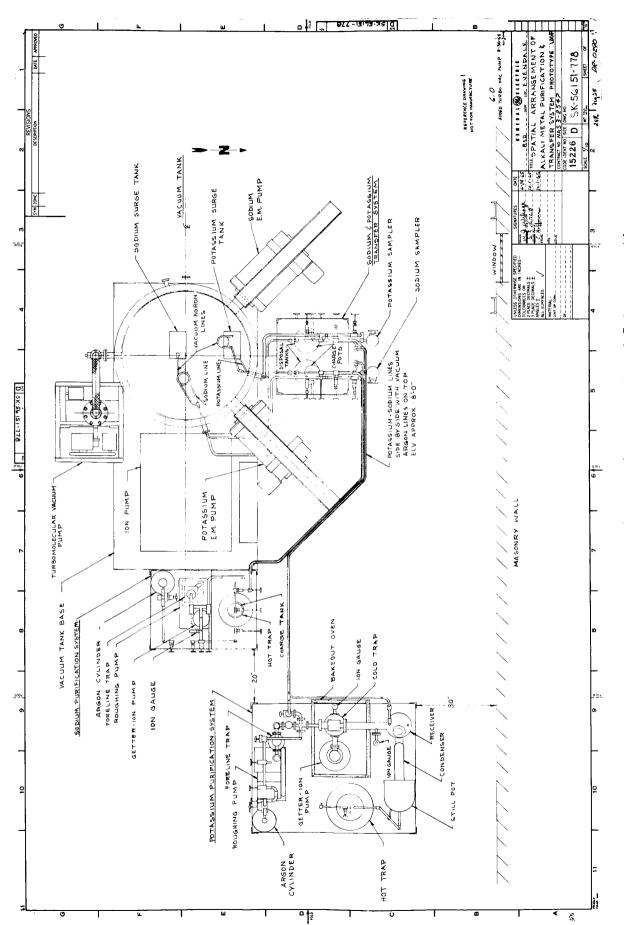
Figure 23. Sodium and Potassium Transfer Systems - Prototype Loop. (Orig. C65040926)



Simplified Schematic of Sodium and Potassium Purification and Transfer Systems for the Prototype Corrosion Loop, Figure 24.

C1079-24

-39-



Plan View Showing Spatial Arrangement and Interconnecting Lines Between Purification Systems, Transfer Systems and Loop. Figure 25.

Sight Port -Overflow Reservoir Fill and Overflow Line Vacuum-Argon Line Conoseal Tube Union To Vacuum-Argon Manifold Conoseal Tube Union To Fit Sample Source C1079-26

Figure 26. Alkali Metal Sampling Device. (Orig. C65073022)

was taken for analysis. For detailed procedures for filling the Prototype Loops see Appendix III.

### C. Analytical Results

The results of the analyses performed on the various Prototype Loop samples are presented in Table III. These data indicate that the sodium transfer system flush may have increased the oxygen concentration of the sodium. However, the oxygen concentration in the sodium was apparently back to its original level after the loop flush. The metallic impurities in the sodium showed no changes in concentration as a result of filling the loop. Likewise, the various potassium handling operations apparently had little effect on impurity concentrations. Again both metals introduced into the Prototype Loop met the purity specification shown in Table III.

A sample of the NaK (eutectic) was obtained by Taylor Instruments during the filling operation, using the sampling apparatus shown in Figure 10. The analytical results are shown in Table III. They indicate that the purity of the NaK was well within the acceptable impurity limits which are also shown in Table III.

TABLE III. ANALYSES OF ALKALI METALS FOR THE PROTOTYPE CORROSION LOOP SYSTEM

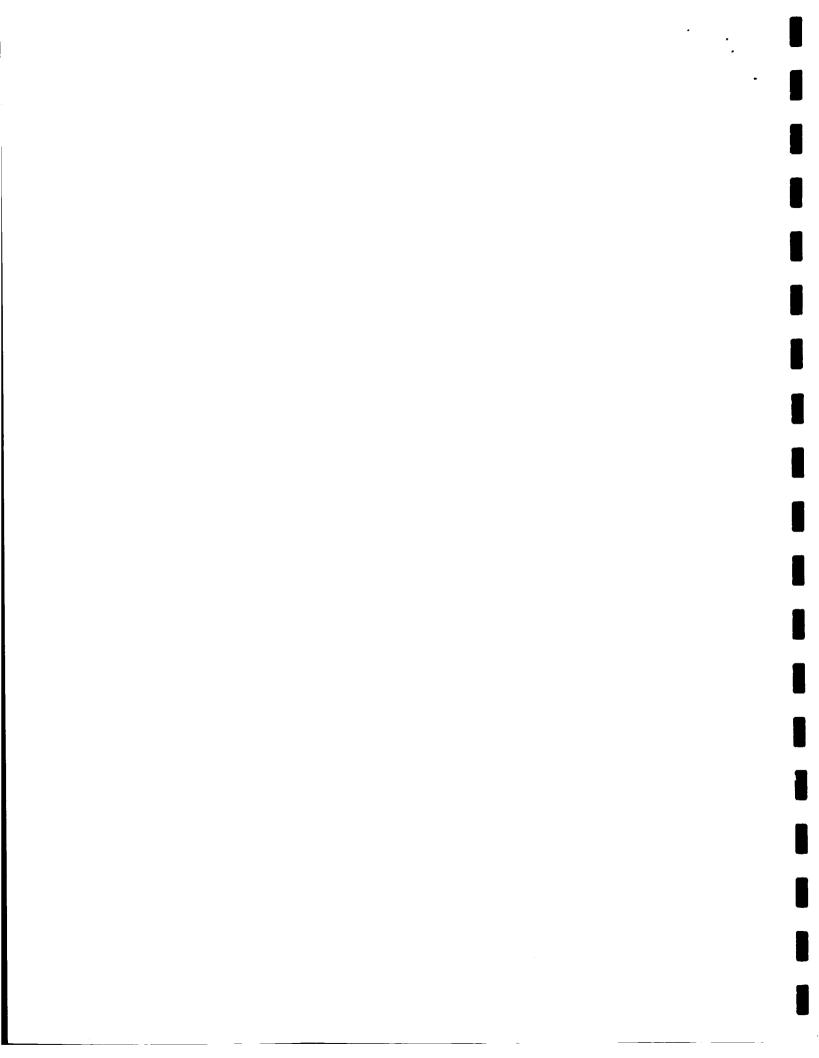
| Sample  | Sample         | Oxvgen.      | Oxvgen. (3) Oxygen Avg (1) |                        |    |          |            |                  |                |         | wdd      | ppm in Alkali Metal | tali M   | etal   |               |                   |        |        |                                       |      |    |        |      |       |       |            |
|---|----------------|--------------|----------------------------|------------------------|----|----------|------------|------------------|----------------|---------|----------|---------------------|----------|--------|---------------|-------------------|--------|--------|---------------------------------------|------|----|--------|------|-------|-------|------------|
| Identity  | gms            | ppm          | mdd                        | Fe                     | B  | ပ        | w          | A1               | M B            | Sn      | 미        | Pb Cr               |          | Si Ti  | i.<br>Ni      | ا <u>چ</u><br>ا ب | >      | / Be   | A                                     | Šŗ   | Sr | Ba     | Ca   | ×     | Na    | Cp         |
| Sodium hot trap before<br>primary fill, No. 204   | 4.306          | 4.1<br>8.9   | 6.5                        | ۳<br>۷                 | ŀ  | స్త      | m<br>V     | ო<br>∨           | ,<br>33        | <13 <   | e .      | ر<br>ع              | £ >      | 8 .    | . 8           | .∍ €>             |        |        |                                       | •    |    |        | (25  |       |       | ا <u>ش</u> |
| Sodium after transfer<br>system flush, No. 232    | 4.174          | 11.5<br>17.0 | 14.3                       |                        |    |          |            |                  |                |         |          |                     |          |        |               |                   |        |        |                                       |      |    |        |      |       |       |            |
| Sodium after primary<br>loop flush, No. 234       | 4,552          | 5.4          | 6.4                        | ж<br>У                 | 1  | × >3     | <b>8</b>   | ° ×              | ٧<br>٧         | <13 <   | 8<br>√   | <i>့</i><br>ဗ       | .3<br>∴3 | <13 <  | v<br><b>e</b> | ٧<br>چ            | <3 <25 | ئ<br>ع | ္                                     | <13  | 1  | 1      | ဗ    | 1     |       | က          |
| Potassium before hot<br>trapping,No. 213          | 1,916<br>3,961 | 4.<br>6.2    | 5.2                        | N                      | 1  | <b>%</b> | <b>8</b>   | 81               | 8 >            | \<br>   | <b>7</b> | <b>63</b>           | <2 1     | ) or   | <b>8</b>      | 2 2               | 2 / 2  | 5      | √<br>23                               | <10  | ł  | ;      | 10   | 1     | 20    | ∾          |
| Potassium after hot<br>trapping, No. 216          | 3,777          | 7.1          | 7.1                        |                        |    |          |            |                  |                |         |          |                     |          |        |               |                   |        |        |                                       |      |    |        |      |       |       |            |
| Potassium after<br>distillation, No. 229          | 4.090          | 3.9          | 4.0                        | 8                      | ;  | 8        | 81<br>V    | \<br>\<br>\<br>\ | 22             | ,<br>21 | .∧<br>Ø1 | ;<br>;              | 81       | ٧<br>8 | .;<br>8       | 2                 | 0      | 2      | 87                                    | <10  | ;  | !      | 87   | ·     | 20    | 7          |
| Potassium after transfer<br>system flush, No. 233 | 4.321          | 5.7          | 6.2                        |                        |    |          |            |                  |                |         |          |                     |          |        |               |                   |        |        |                                       |      |    |        |      |       |       |            |
| Potassium after secondary<br>loop flush, No. 235  | 3.980          | 5.6          | 7.2                        | <b>8</b>               | 1. | 87       | ×<br>×     | 87               | 81             | (10     | <2 <10   | •                   | 2 < 10   | 0 < 2  | 2             | 1                 | - <10  |        | 83                                    | < 10 | 1  | ;      | Ø    |       | 20    | 73         |
| NaK(78) used in pressure<br>transducers, No. 173  | 3,268          | 8.5<br>8.5   | 3,8                        | <10 <sup>(2)</sup> <10 |    | . 10     | <b>2</b> × | > 01>            | N <sub>1</sub> | 10      | . 2 . 10 | 0 710               | 0 20     | 0 <10  | 0 < 10        | 0 <10             | 0 <10  | · 5    | × × × × × × × × × × × × × × × × × × × | √20  | 8  | ^<br>4 | 8    |       | ;     | :          |
| Sodium, potassium and<br>NaK purity requirements  |                |              | 20                         | 25                     | 65 | 25       | 25         | 25 2             | 25             | 25 25   | 25 28    | 25 25               | 5 65     | 5 25   | 5 25          | 5 25              | 40     | 25     | 52                                    | 25   | 25 | 25     | 25 5 | 500 5 | 500 2 | 22         |
|   |                |              |                            |                        |    |          |            |                  |                |         |          |                     |          |        |               |                   |        |        |                                       |      |    |        |      |       |       |            |

(1) Oxygen calculated as monoxide by titration - avg. ppm = total  $\mathcal{A}$ gms divided by total sample weights

(2) Analyzed by Nuclear Materials and Equipment Corporation, Apollo, Pa.

(3) Analytical blank, 5-10 µgms oxygen per sample, not subtracted.

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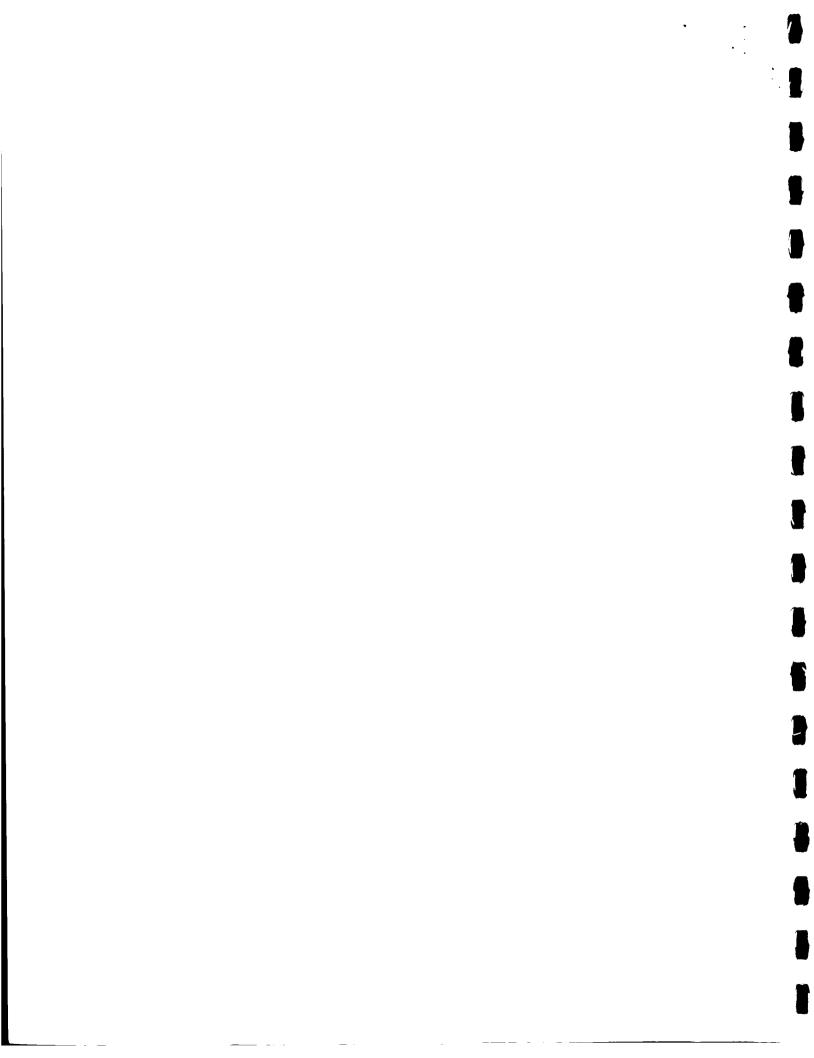


### V. SUMMARY AND CONCLUSIONS

Purification systems and handling equipment were designed, built and operated to provide the alkali metals used in the three corrosion loop systems. The purification methods used were filtration, hot trapping and vacuum distillation - the latter method being used for potassium only. The handling equipment for Loop I was quite simple and the pressure change technique was used to fill the loop. The handling system for Loop II and the Prototype Loop included charge pots of known volume for filling the loops and utilized oven-heated transfer lines where possible.

The sodium, potassium and eutectic NaK used in the three loop systems was analyzed for oxygen by the amalgamation method and for metallic impurities by emission spectrography. In all cases the alkali metals used in the loops were of the desired purity as determined by the analyses.

The hot traps and the still operated as expected with no real problems encountered during operation. A complete set of drawing lists and drawings of the alkali metal purification and handling systems for all three corrosion loops is contained in Appendix IV.



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|------------------------------|--------------------|
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| Report No. 2 (NASA-CR-54008) | January 15, 1963   |
| Report No. 3 (NASA-CR-54081) | April 15, 1964     |
| Report No. 4 (NASA-CR-54167) | July 15, 1964      |
| Report No. 5 (NASA-CR-54269) | October 15, 1964   |
| Report No. 6 (NASA-CR-54344) | January 15, 1965   |
| Report No. 7 (NASA-CR-54735) | April 15, 1965     |
| Report No. 8 (NASA-CR-54843) | July 15, 1965      |
| Report No. 9 (NASA-CR-54912) | October 15, 1965   |

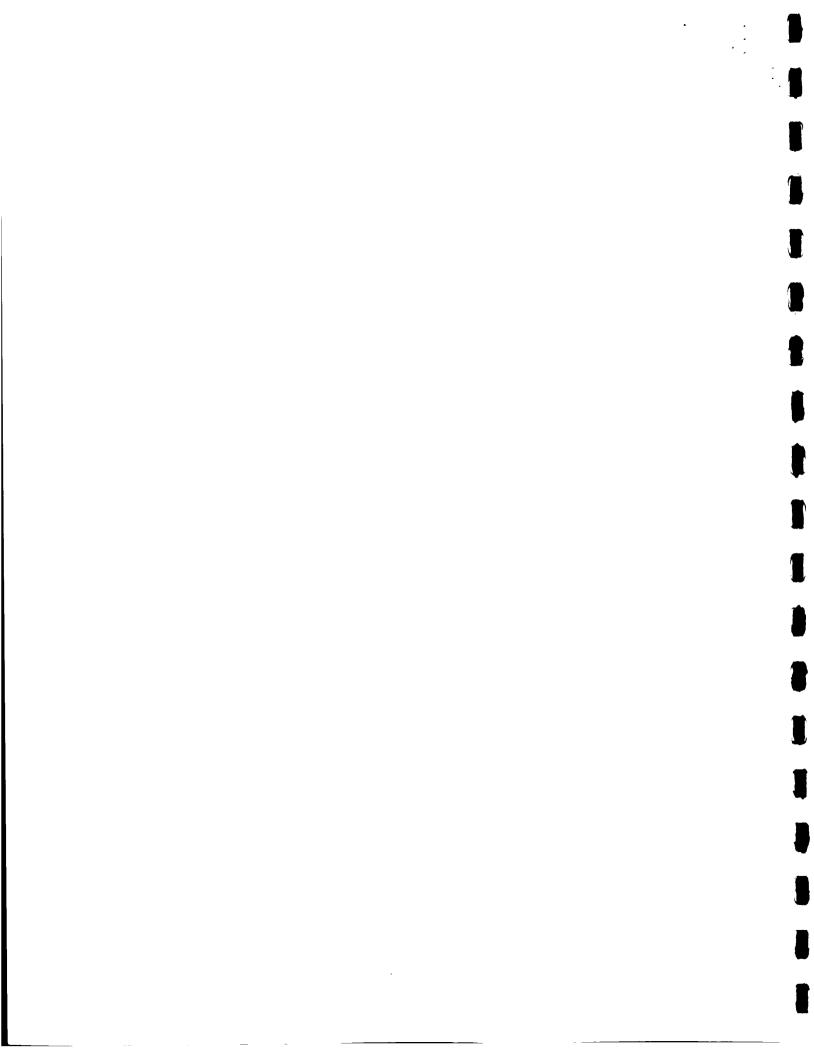
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Report No. 10 (NASA-CR-54990)

Report No. 1 - "Purification and Analysis of Helium for the Welding Chamber" by T. F Lyon, NASA-CR-54168, July 1, 1965.

January 15, 1966

- Report No. 2 "Material and Process Specifications for Refractory Alloy and Alkali Metals" by R. G. Frank, D. N. Miketta, W. H. Kearns, W. R. Young, and R. B Hand, R66SD3007, December 13, 1965.
- Report No. 3 "Material Specifications for Advanced Refractory Alloys" by D. N. Miketta and R. G. Frank, NASA-CR-54761, October 1, 1965.



### APPENDIX I

### COMPONENT EVALUATION TEST LOOP I FILLING PROCEDURE AND SYSTEM

Contract NAS 3-2547

### COMPONENT EVALUATION TEST LOOP I FILLING PROCEDURE

The step-wise filling procedure to be used for Component Evaluation Test Loop I is as follows; referring to Drawing SK56131-490, Figure 27:

- 1. Wrap all Cb-lZr parts of the test loop with aluminum foil and then the necessary heating tapes over the foil.
- 2. Weigh the test loop carefully and record the weight.
- 3. Check the loop valve orientation the direction of flow should be toward the loop, i.e., the bellows should be on the loop side.
- 4. Attach the loop to the filling system with a 3/8-inch stainless steel "Swagelok" fitting.
- 5. Tighten "Swagelok" fitting at valve 8. All other connections between valves and fill lines are welded.
- 6. Attach thermocouples to loop at four locations to assure that the loop temperature does not exceed 250°F during filling.
- 7. Wrap valves, fill lines and hot trap with heating tapes rated at 500°F maximum.
- 8. Evacuate fill lines and gas lines to 50 microns with roughing pump only.
- 9. Close valve 5 and backfill to 17 psia by opening valve 1.
- 10. Repeat 9 and 10, four times.
- 11. Close valves 1, 2 and 3, open valve 5 and turn on diffusion pump when pressure reaches 100 microns.
- 12. With valve 9 still closed, pump the fill system down to  $1 \times 10^{-4}$  torr and add dry ice and acetone to the cold trap flask.
- 13, Heat the transfer system and loop to 250°F and outgas until the leakup rate is less than one micron-liter per minute.
- 14. Open valve 9.
- 15. Evacuate entire fill system and loop and determine the leak rate maximum permissible leak rate 1 micron-liter per minute.
- 16. Close valves 5 and 6 and backfill to 17 psia with argon. Open valves 2, 3 and 7 and readjust argon pressure to 17 psia.

- 17. Close valve 1 to argon supply.
- 18. Open valve 8 and fill loop until pressure drops to the predetermined pressure (pressure change that indicates 100 grams of sodium transferred) then close valve 8.
- 19. Open valve 6 to clear fill lines and pressurize loop.
- 20. Close valve 9.
- 21. After fill lines are cleared close valves 4 and 6. Check valve 9 for closed position.
- 22. Break "Swagelok" fitting to loop after sodium has solidified.
- 23. Plug "Swagelok" fitting to sodium sample tube until ready for analysis.
- 24. Clean valve connection to valve seat using water or steam depending upon the quantity of sodium involved. When clean check the wash water for alkalinity with phenolphalein.
- 25. Reweigh loop sodium weight should be 114 grams 10%. Step 18 involves the use of a pressure change technique employed in SPPS and described in Specification 03-0018-00-A (Reference 7). This method can be used for small quantities of liquid metal in the 20 to 200 cc range with accuracy of 10%.

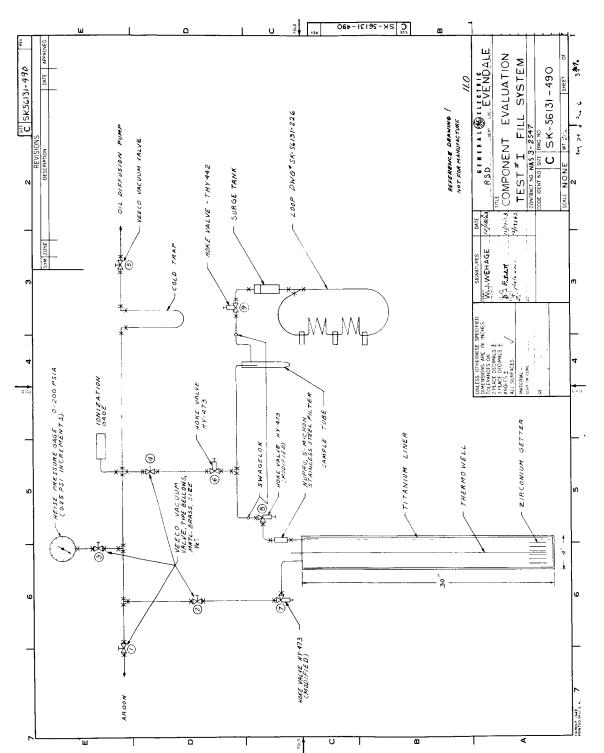


Figure 27. Component Evaluation Test Loop I Fill System.

### APPENDIX II

### COMPONENT EVALUATION TEST LOOP II FILLING PROCEDURE AND SYSTEM

Contract NAS 3-2547

# LOOP II FILL PROCEDURE

All specifications Referring to the schematic drawing SK56131-497 shown in Figure 28, the procedure for flushing the transfer system, referred filling

| ling Loop II, and obtaining samples is as follows, as:<br>erred to in this Appendix are presented in Reference | s is a<br>sented | s fo.<br>in ] | suming valves A and D have been cleaned.   | All specificat |
|--|------------------|---------------|--|----------------|
| Operation  |                  |               | Procedure  | Remarks        |
| Connect the sodium purification system to the transfer system  | Α.               | (1)           | Connect valve S to valve L with a 5/8" tube Conoseal union.  |                |
| and install the sampling system.   |                  | (2)           | Connect valve D to valve E with $1/2$ " tube Conoseal unions.  |                |
|  |                  | (3)           | Connect sampling system between valves I and J using 1/2" tube Conoseal unions.  |                |
| Helium leak-check all Conoseal unions and welds in the connect-  | B.               | (1)           | Attach the helium leak detector to valve Q.  |                |
| ing lines which have not been previously leak-checked.   |                  | (2)           | Evacuate the lines to be leak-checked through valve Q with valves C, P, U, W, T, M, D, and K closed and valves R, S, L, H, G, I, J, N, F, and E open.        |                |
|  |                  | (3)           | Leak-check the fittings in question at maximum sensitivity $(5 \times 10^{-11})$ std cc/sec) with maximum leakage of $5 \times 10^{-10}$ std cc/sec allowed. |                |
|  |                  | (4)           | When system is leak-tight, close valve Q and detach the leak detector.   |                |
| Outgas and helium leak-check the transfer system at $250^{\circ}$ - $300^{\circ}$ F,                           | ບ                | (1)           | Turn on oven heaters in purification dolly and transfer system enclosure.  |                |
|  |                  | (2)           | Turn on heating tapes which may be required in addition to oven heaters on some components; e.g., sample flush   |                |

В.

-56-

reservoir or bellows in right angle

ပ္

valves such as D.

Remarks

- With valves in same position as in valve T and evacuate the transfer B(2), EXCEPT WITH Q CLOSED, open system to 10-20 microns Hg (3)
- Open valve W and start ion pump; turn off valve T when iqn pump is operating properly. (4)
- Pump on transfer system at 250-300°F until the pressure rise rate does not exceed one micron-liter per minute, (2)
- lines at 2502300°F by flooding the hottom. Maximum allowable leakage  $5 \times 10^{-10}$  std cc/sec. W, open valve Q and leak-check all detector to valve Q, close valve During the outgassing operation, anclosures with helium from the again attach the helium leak (9)
- Load charge pot. (1) D.
- Check that valves A, Close valves S & W . ھ
- Open valves T & P and svacuate ઝ ىي Ξ. are closed. þ.

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Close valve T, open valve U, open line between valves P & A to 10 valve V and backfill lines with microns Hg. ъ

argon to 15 psia.

Repeat steps c and d three times to assure that line between P & A contains pure argon. e e

system and sample sedium prior

to loop filling.

Prepare to flush the transfer D,

- Check and adjust hot trap gas pressure to 20 psia by opening valves U, P & A and venting thru valve R or pressurizing thru valve V.
- g. Close valves A, P, U and V.
- h. Check that valves B, D. Q. W & S are still closed.
- . Open valves T, R, & C, evacuate charge pot to 10 microns and close valve C.
- j. Close valve R, open valves P, U & A and note pressure in hot trap. Repressurize to 20 psia thru valve V if necessary.
- k. Check temperatures of hot trap, charge pot and filter to assure that lines are at least 250°F.
- 1. Open valve B and fill charge pot, noting pressure decrease in hot trap which should correspond to that required to fill the charge pot.
- m. Close valves A & P with hot trap pressure below 17 psia.
- n. Pressurize line above valve C to 20 psia thru valve V.

Remarks

Operation

- closed without a gas pressure Close valve B and IMMEDIATELY OPEN valve C to minimize the time the liquid metal is enbuffer. ô
- Adjust pressure on charge pot to 20 psia. **b**•
- Close valves F, G. H. I, J, K, N, M, L, E and D.  $\Box$ ьů

Prepare to flush transfer

E.

system and take sample.

- Check and record temperatures of all transfer sections to assure 250°-300°F. (5)
- between valves D and E. Record final pressure on charge pot and repressurize to 20 psia. Open valve D and fill line (1)٠ [كرا
- Open valve E and fill line between valves E, G. and F. Record final pressure on charge pot and repressurize to 20 psia. (5)
- Open valve G and fill line between valves G, I and H. Record final pressure on charge pot and repressurize to 20 psia. (3)
- on steps (1), (2), and (3), calculate From pressure change data obtained pressure change in charge pot for removing one pound of sodium. (4)
- Record charge pot pressure and repressurize charge pot indicates one pound has flushed lines bounded by valves D, Open valve H and flow sodium into disposal tank until pressure in E, F, I and the disposal tank, to 20 psia. (2)

Flush transfer system and

take sample.

NOTE: J Tube level indicator in disposal tank must be calibrated while flushing transfer lines.

Therefore, pressure in charge pot should be recorded when the sodium level first contacts the J tube for the first calibration point. The final pressure in the charge pot after the one pound transfer will allow the determination of a second calibration point.

- (6) Close valve H, open valve F and fill line between valves F, K and J. Record final pressure on charge pot and repressurize to 20 psia.
- (7) Open valve J and fill sampler between valves J, I and N. Record pressure on charge pot and repressurize to 20 psia.
- (8) Repeat calculation of step (4) for one pound of sodium, close valve G, open valve H and flush one pound of sodium through sampler and close valve H. Record final pressure in charge pot and repressurize to 20 psia.
- (9) Close valve I, open Valve G immediately, open valve N and flush contents of sampler into sample flush reservoir.
- (10) Close valve N and turn off oven heaters and tapes.
- (11) Close valve J, remove front panel from transfer system and oven and direct fan on sampler to cool as rapidly as possible.

Remarks

for 0 and metallics as soon as possible. Disconnect sampler at valves I and J when sodium is frozen and analyze

(12)

Clean valves I and J in accordance with the valve cleaning procedure. (13)

Spec. No. 03-0018-00-A, Alkali Metal Handling and Control

Procedures.

- Refill charge pot following procedure detailed in step D(1) except leave valves D, E, G and F open with valves H, I, J, K and B closed, G.
- Prepare sampler with flush reservoir large enough to hold volume of lines bounded by valves F, K, I and N and attach to valves I and J. (1)

Η.

- voir and leak-check sampling system at maximum sensitivity (5 x  $10^{-11}\,\mathrm{std}$ Attach leak detector to flush reserleakage of 5 x  $10^{-10}$  std cc/sec. cc/sec) with maximum allowable (3)
- and repeat step (2) when temperature Turn on transfer system oven heaters reaches 250°300°F. (3)
- Attach valve P to flush reservoir with Swagelok fittings with valves P, and A austonitic stainless steel tubing and closed. (4)
- and N thru valves R and T with valves Evacuate the line between valves P C, Q, U, W, S and A closed. (2)

Attach new sampler, leak-

Refill charge pot.

ე.

Ħ.

check and outgas.

- (6) Open valve N when pressure reaches 10-20 micron Hg open valve W and turn on ion pump. When ion pump is operating, close valve T and turn on dolly oven heaters and heating tapes to bring system up to transfer temperature.
- (7) Measure leak-up rate of sampler between valves N, I and J. Maximum leak-up rate allowed is I micron-liter per minute.
- (1) Check valves as follows: A, B,
   P, Q, R, V, L, M, H, I, J and K
   closed; U, C, D, E, G, and F
   open.
- (2) Pressurize charge pot to 25-30 psia.
- (3) Record temperatures in transfer system to assure that lines are 250-300°F.
- tank. When charge pot pressure reaches 6-8 psia, close valve F and pressurize charge pot to 15-16 psia, re-open valve and finish filling surge tank. Sudden pressure rise on loop pressure gauge will indicate when charge pot and transfer lines between valves D and K are cleared.
- (5) Close valve K, pressurize loop surge tank, and circulate sodium in loop for one hour at 500°F.

resumpled. If the exygen con-

tent is less than 20 ppm the

oop surge tank is filled at

this point,

ppm O in sodium, the transfer

If the transfer system flush sample contains more than 20

Ĥ

system must be reflushed and

Sample sodium in loop.

٦.

٦,

- Procedure
- by obtain homogeneous metal in surge from loop into surge tank and there-Evacuate surge tank to pull sodium tank. (3)
- Pressurize surge tank to 25 psia for removing sample. 3
- Evacuate transfer system between valves F, K and J as follows: (3)
- pot and lines to about 10 microns. S closed, close valve U, open With valves in same position valves T and evacuate charge as in I(1) check valves W & . ਲ
- assure that filter is not causing between the vacuum gauge and the show no pressure rise when valve transfer lines between F, K and a significant pressure drop J. The vacuum gauge should Open valves S, L, and H to H is opened. Ď.
  - Close valves H, S, L, C and F. ပ်
- Check valves N, P and J closed. (4)
- pressure change on surge tank pres-Open valve K and fill line between sure gauge which indicates flow. valves F, K and J, observing (2)
- Open valve J and again observe pressure change to assure that sampler is full of sodium. (9)
- Open valve N and fill sample flush reservoir. 3
- Turn off oven heaters and heating tapes. (8)

- (9) Close valves N, J and K.
- (10) Again cool sampler, remove and analyze for O and metallics as soon as possible.
- (11) Clean valves I and J according to the valve cleaning procedure.

Spec. No. 03-0018-00-A, Alkali Metal Handling and Control

Procedures

- K. (1) Check valves C, B, L, M, H, I, J, F and K closed.
- (2) Open valve F and heat transfer system to  $250^{\circ}-300^{\circ}F$ .

pe

charge in surge tank must

discharged into disposal tank, as indicated under

"Procedure."

Otherwise, impure

begun.

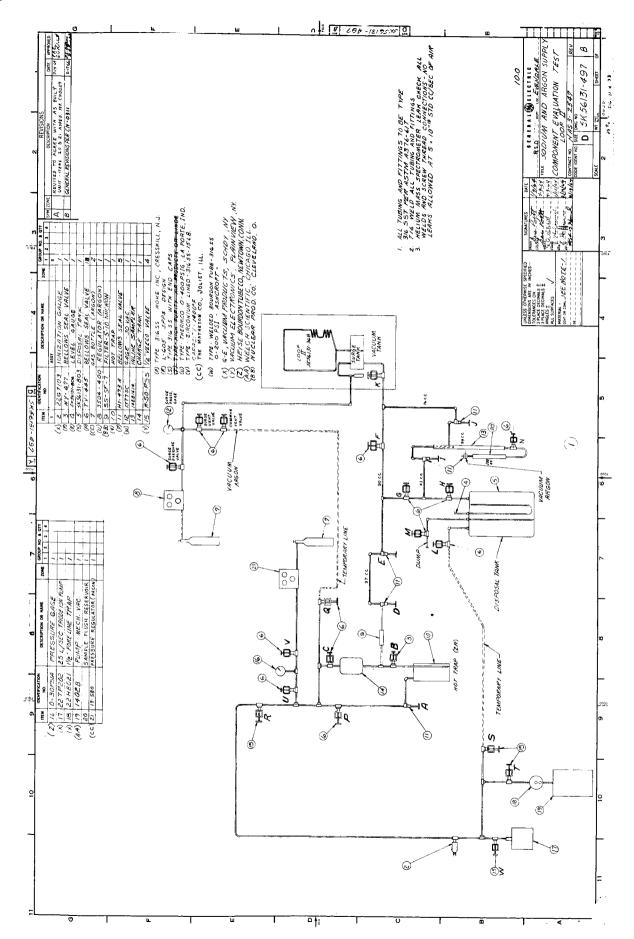
indicates less than 20 ppm

0, loop operation may be

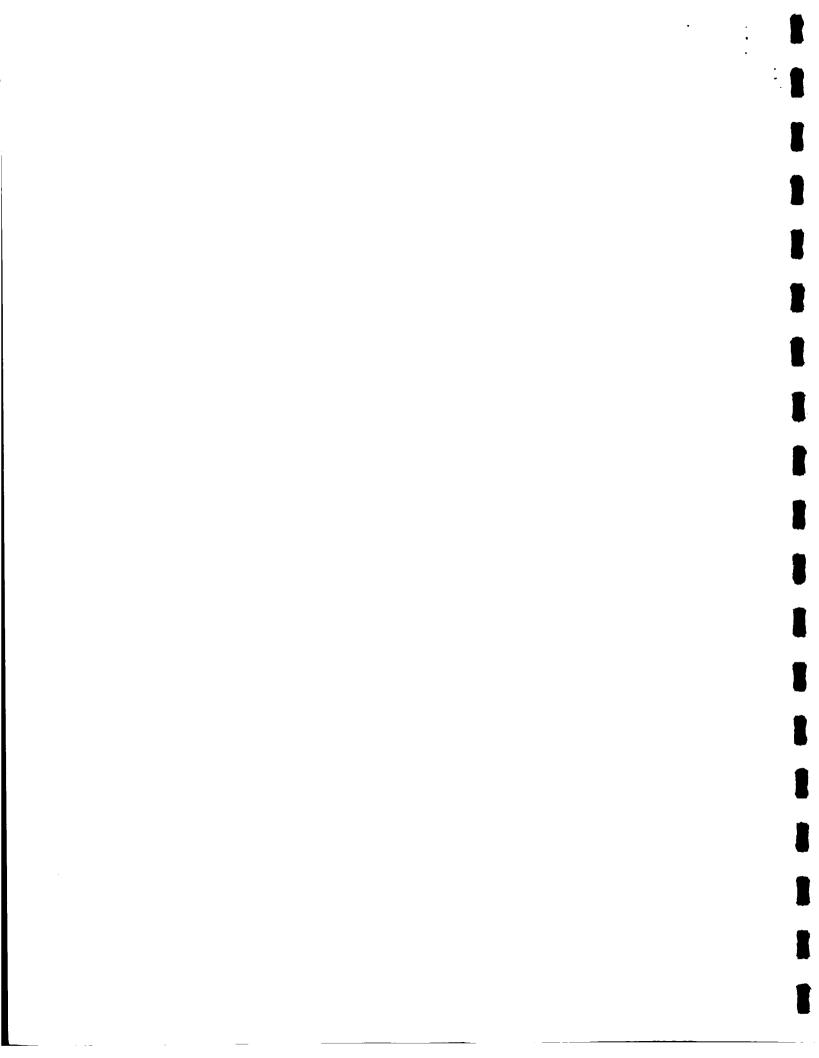
If analysis of the sodium

K

- (3) Pressurize surge tank to 30 psia.
- (4) Open valves L, S, U and R; close valve T.
- (5) Check valves P, C, Q, V and W closed.
- (6) Close valve E, open valve H, open valve K and dump sodium from surge to disposal tank; pressure increase of Heise gauge between valves U and V will indicate when surge tank is empty.
- (7) Close valves K, H, L and S, and open valve E.
- L. Repeat entire flushing procedure described in first nine steps to obtain pure loop charge if step K is necessary.



Sodium and Argon Supply, Component Evaluation Test Loop II. Figure 28.



#### APPENDIX III

#### PROTOTYPE CORROSION LOOP FILLING PROCEDURES AND SYSTEMS

Contract NAS 3-2547

## PROTOTYPE LOOP

# POTASSIUM PURIFICATION AND LOOP FILLING PROCEDURE

All Specifications referred to in this Appendix are presented in Reference 7.

## Operation Outgassing of Potassium To remove dissolved and occluded gases and to decompose any hydride which may be present.

\_;

(a) Attach the shipping container gas valve to valve C of the vacuum-argon manifold, and attach the shipping container dip leg valve to valve Q on the hot trap.

Procedure

- (b) Outgas the potassium according to Specification 01-0034-00-B.
- (a) Attach valve P on the hot trap to valve D on the vacuum-argon manifold.

. 0

- (b) Outgas the hot trap as indicated in Specification 01-0034-00-B.
- 3. (a) Transfer the potassium to the hot trap and hot-trap it according to Specification 01-0034-00-B.
- 4. (a) Close the gas valve on the shipping container and detach from valve C.

nitrogen from the potassium,

oxygen, carbon, and

s S

Hot Trapping of Potassium To remove impurities such

.

determination of oxygen and

metallic impurities.

To obtain a specimen for

Sampling the Potassium -

Refer to Figure 29

- (b) Attach a sampler (See Figure 30 and item 53 of Figure 29) by connecting valve JJ on the sampler to valve O on the hot trap; and valve II of the sampler to valve C.
- (c) With valves O and KK closed, evacuate leak-check and bakeout the sampler through valve C. The helium mass spectrometer may be attached to valve F. The pressure rise rate and leak rate should be as specified in Specification 01-0034-00-B.

## Remarks

Specification No. 01-0034-00-B defines and specifies the important parameters in the outgassing procedure.

from the internal surfaces

of the hot trap.

To remove adsorbed gases

Outgassing of Hot Trap

7

Remarks

## Procedure

- (d) Close valves II and C with the sampler evacuated to less than 10 torr.
- (e) Pressurize the hot trap with argon to about one atmosphere through valves D and P and heat the entire hot trap and sampler, including valves O and JJ, and the transfer lines to about 400°F.
- thus admitting potassium to the sampler. Using the sampler sight port, overflow the potassium into the cup until the cup is about 1/4 full to flush the sample tube and obtain a sample.
- (g) Close valves 0 and JJ.
- (h) Cool sampler, hot trap and remainder of system to room temperature and remove sampler between valves JJ and O, and between II and C.
- (i) Analyze potassium for oxygen and metallics.
- (j) Clean valve 0.
- (a) Attach hot trap to still at valves O, N and M as shown.

5.

(b) Close valves E and H and fill sorption pump with liquid nitrogen, and rough pump high vacuum and still systems through valves G, I, J, and K with valves N and M open and O and L closed. Leak check through valve F with valve G closed.

5. Outgassing of Still and
High Vacuum System To remove adsorbed and
absorbed gases from walls

## Procedure

- (c) Heat all parts of the still to between 250° and 300°F and the high vacuum system to between 350° and 400°F. The forepump system should be heated to about 150°F.
- (d) Leak-check system while hot through valve F with valve G closed.
- pump. Continue outgassing until pressure rise rate is less than 5 x 10<sup>-3</sup> torr-liters per hour with system hot and less than 10<sup>-3</sup> torr-liters per hour with system cold. The pressure in the still when cold should be less than 10<sup>-6</sup> torr with ion pump on.
- 6. (a) Reconnect hot trap to vacuum-argon manifold between valves C and Q.

Preparing to Distill

.

- (b) Heat the hot trap and lines connecting it to the still to about 300°F. Heat the still pot to between 500° and 600°F and the condenser to 200° to 225°F.
- (c) Reduce pressure in still to below 10<sup>-5</sup> torr and add liquid nitrogen to the Cryosorb cold trap.
- (d) Pressurize hot trap to about 20 psia through valves C and Q.
- (e) Close valves N and M and open valve0, thus filling transfer lines tovalves N and M.

Rough pump system to 10-20 microns with sorption pump, start pump, close valve G and pump out sorption pump with mechanical pump.

## Remarks

## Procedure

- (f) Determine liquid level in hot trap by temperature profile and by level indicator. Also record temperature profile of still pot.
- (a) Open valve M and fill annular space in condenser with potassium and overflow to fill still pot to bottom of thermo well, close Valve M.

7

Distilling

.

(b) Open valve N and fill still pot to weld at bottom of elbow. Determine level by temperature profile.
Check potassium transferred by pressure drop in hot trap and level indicator.

potassium level in the Bearing Materials Program still.

Adjust air flow rate through

cooling coils.

the temperature profile method

may be used to determine the

It has been demonstrated that

- (c) Distilling will commence at this point and the condenser temperature must be adjusted so that its outlet does not exceed 200°F
- (d) Increase the still pot temperature until the distillation rate is at least one pound an hour as determined by the level rise in the receiver.
- (e) Continue distillation until receiver is full to bottom of condenser outlet, then stop distillation and cool entire system to room temperature.
- (a) Attach sampler by connecting valve JJ on sampler to valve L of still receiver. Evacuate sampler through valves II and DD with JJ open and L closed.

Distilling may be stopped abruptly at any time by admitting argon to the still, All heating must be stopped at the same time.

8

## Procedure

- (b) Pressurize still to no more than 10 psia.
- (c) Take sample through valve L as described in operation #4.
- (d) Close valves L and JJ and analyze potassium.
- (e) Clean valve L.

Spec. No. 03-0018-00-A, Alkali

Metal Handling and Control

Procedures.

Valve R is necessary only when

both systems have been used before, thus permitting outgassing and leak checking of transfer line through valve R.

9. (a) Connect still and transfer systems between valves L and S.

Outgas sing Transfer System and

Loop

60

- transfer system and leak check transfer system and samplers to valves L, W, FF and DD through valves N and Z or Y. Continue bakeout until pressure rise rate is less than 10<sup>-3</sup> torr liters per minute.
- (c) Rough pump loop through valves CC and EE with BB closed.
- (d) Close valve CC and evacuate, bakeout and leak check loop through valves DD and EE with valves X, Y, FF and HH closed.
- Close valves V, U and HH. closed. (a) 10. Flushing Transfer System and Charge Pot - To remove

contaminating materials

10.

from surfaces.

1. S

FF

- (b) Heat still receiver, transfer lines, transfer system, charge pot and sampler to 200°F.
   (c) Open valve L. Still has about 10
  - Open valve L. Still has about 10 psia argon pressure in it and the rest of the system is evacuated, so the lines and charge pot will be completely filled.

## Procedure

Remarks

- Close valve L. (g
- Pressurize transfer system gas to about 20 psia and open valve HH. (e)
- Open valve V and empty entire charge pot system into disposal tank. (t)
- Open valve U to clear the short line at the tee and empty the valve. (g)
- Evacuate transfer system and close valves U, V, HH and II. (h)
- Repressurize still if necessary. (i)
- Refill charge pot through valve L. (j)
- Repressurize transfer system gas lines to about 20 psia and open valve HH. (K)
- Open valve U and take sample. (a) 11.

Sampling the Potassium

11.

- Close valves U and JJ, remove sampler and analyze. (P)
- Clean valve U. (၁
- Attach new sampler and evacuate, bakeout and leak check (g
- Evacuate charge pot through valve HH and then close HH. (a) 12.
- Refill charge pot through valve L. <u>@</u>

potassium for transfer To provide known volume

of

to loop surge tank.

Refilling Charge Pot

12.

Filling Loop Surge Tank

13.

DD, Evacuate loop through valves EE, BB and Z with AA and CC closed. (a) 13.

Turn oven heaters off before closing valves U and JJ Spec No. 03-0018-00-A, Alkali Metal Handling and Control Procedures.

- Procedure
- (b) Close valves L and DD.
- (c) Pressurize transfer system gas lines to 30 psia.
- (d) Open valve HH and then valve FF and empty charge pot into surge tank.

  Transfer will be assured by sudden change on pressure gauge in loop surge tank pressure system.
- (e) Close valves FF and DD.
- (f) Evacuate transfer lines through valves HH then close HH.
- (g) Evacuate sampler
- 14. (a) Pressurize surge tank through valves AA, BB and EE to fill loop.

Flushing Loop - To remove contaminating materials

14.

from surfaces.

- (b) Circulate for one hour at 500°F.
- (c) Evacuate surge tank through valve DD with BB closed to dump potassium into surge tank. Allow about five minutes for mixing.
- (d) Repressurize surge tank through valves AA, EE and BB with DD closed.
- 15. (a) Close valves S and GG and open valve FF to fill transfer lines.

Taking Potassium Sample

15.

- (b) Open valve U and take sample.
- (c) Close valves U and JJ.

After turning oven heaters

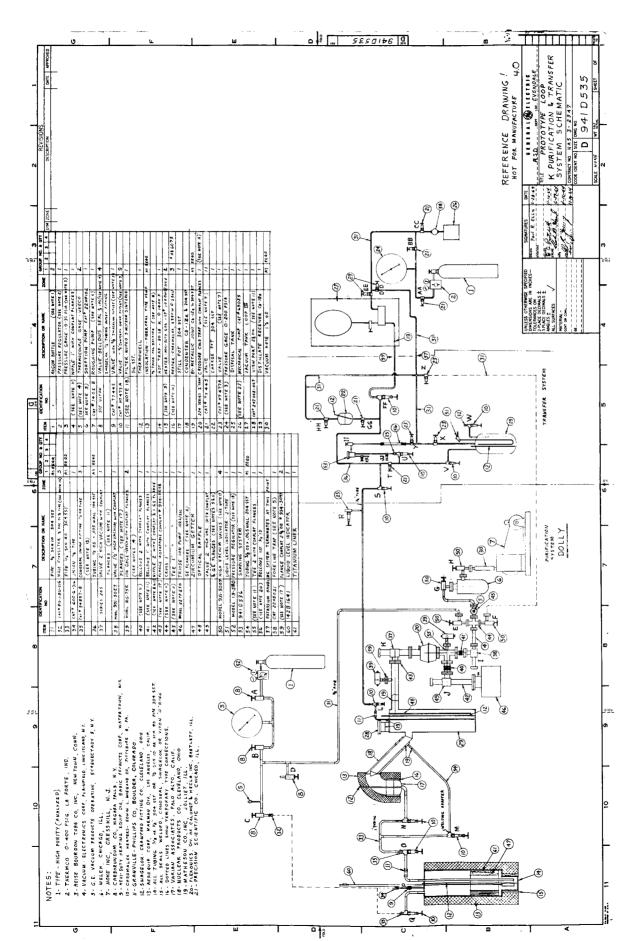
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Procedures

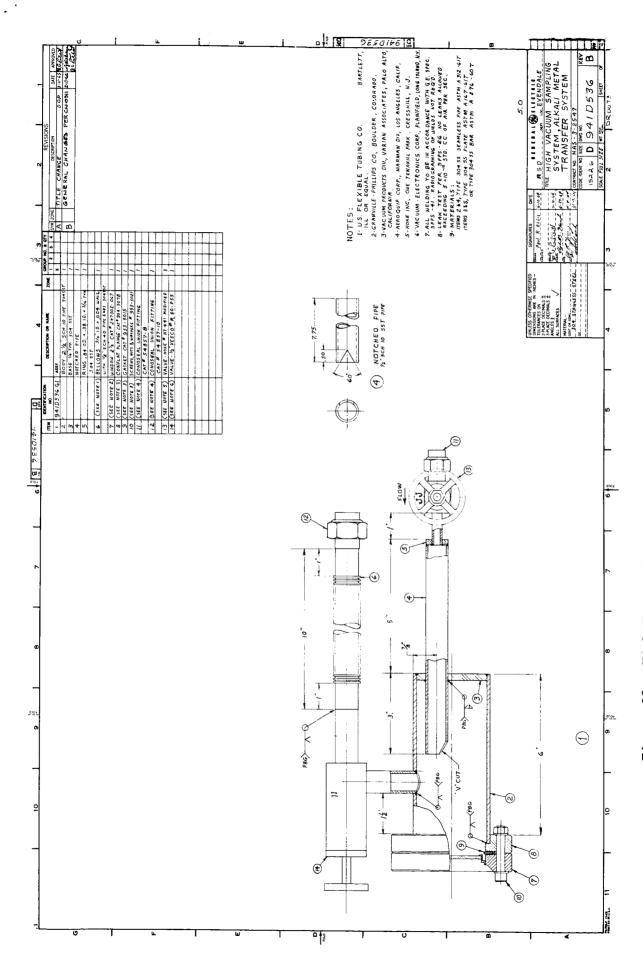
Remarks

Remove sampler and clean valve U. Analyze sample. (p)

V and replace with another charge. Repeat flush and resample until loop; if not, dump surge tank into disposal tank through valve If potassium is acceptable, run potassium is acceptable. (e)



Prototype Loop Potassium Purification and Transfer System Schematic. 29. Figure



High Vacuum Sampling System, Alkali Metal Transfer System. Figure 30.

## PROTOTYPE LOOP

## SODIUM LOOP FILLING PROCEDURE

| Operation   |    | Procedure   | Remarks   |
|---|----|---|---|
| Hot Trapping the Sodium - It will be assumed that the sodium has been hot trapped and is pure.    | i  | Done  | See SPPS Specification No.<br>01-0032-00-B.     |
| Attaching the Sodium Hot Trap -<br>To the transfer system.  | 23 | Weld $1/2$ " austenitic stainless steel tubing between valves L and S.  | See Figure 31.                                  |
| Attaching a Sampler - To obtain<br>a sample after outgassing and<br>flushing the transfer system. | e. | Attach sampler via valves JJ to<br>valve U and valves II to Y.  | See Figure 31.                                  |
| Helium Leak Checking Transfer<br>System.  | 4  | Attach mass spectrometer at valve Z or H and leak check with only valves LL, W and L closed in transfer system.   | 5 x 10 <sup>-10</sup> std cc air/sec allowable. |
| Outgassing Transfer System and Sodium Loop.   | ů. | <ul> <li>(a) Evacuate, bakeout and leak check transfer system and sampler to valves L, W, LL and DD through valves Z or H.</li> <li>Continue bakeout until the pressure rise rate is less than 10<sup>-3</sup> torr-liters per minute.</li> <li>(b) Rough pump loop through valves CC and EE with BB closed.</li> <li>(c) Close valve CC and evacuate, bakeout and leak check loop through valves DD and EE with valves X, Y, FF and HH closed</li> </ul> |   |

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## Operation

- 6. Flushing Transfer System and Charge Pot To remove any contaminants.
- 7. Sampling the Sodium.
- 8. Refilling Charge Pot.
- 9. Filling Loop Surge Tank.
- 10. Flushing Loop.
- 11. Taking Sodium Sample.

## Procedure

- 6. Follow the same procedure with the potassium except the alkali metal source will be the hot trap instead of the still.
- 7. Use the same procedure outlined in 6 above.
- 8. Use the same procedure outlined in 6 above.
- Use the same procedure outlined in 6 above.
- Use the same procedure outlined in 6 above.
- Use the same procedure outlined in 6 above.

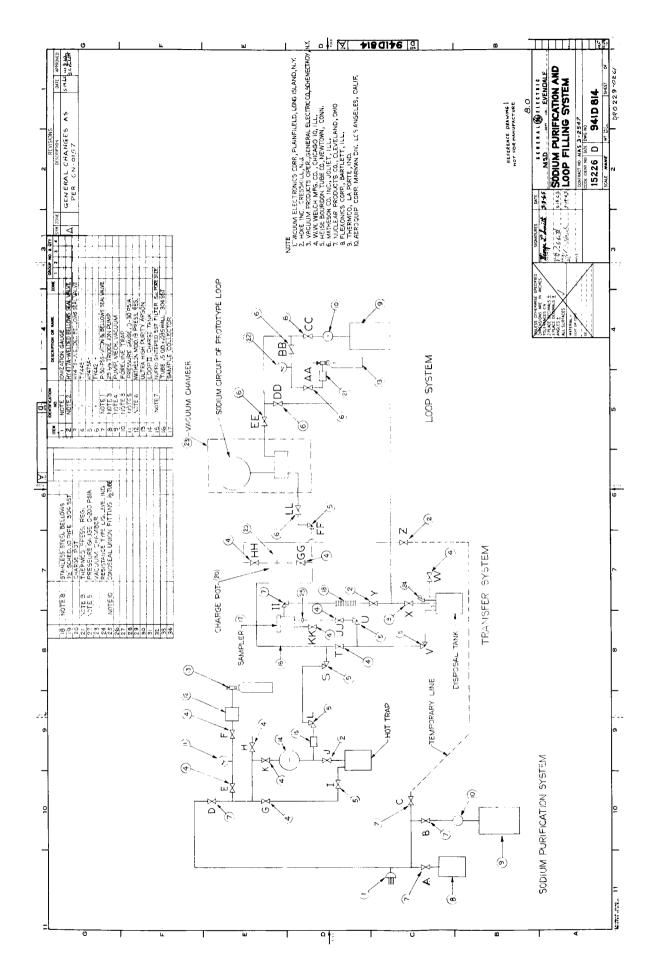


Figure 31. Sodium Purification and Loop Filling System.

#### APPENDIX IV

DRAWING LISTS AND DRAWINGS FOR COMPONENT

EVALUATION TEST LOOPS I AND II AND THE PROTOTYPE CORROSION

LOOP ALKALI METAL PURIFICATION AND HANDLING SYSTEMS

Contract NAS 3-2547



#### SPACE POWER & PROPULSION SECTION

#### LIST OF DRAWINGS

Master Drawing List - Alkali Metal

ASSEMBLY TITLE Purification & Handling - All Loops ASSEMBLY NO.

PAGE 1 OF

| EM                                       |                 | DW | G L | ΕV       | EL                  |                            | ] 1     | ISSUE   |             |
|--|-----------------|----|-----|----------|---------------------|----------------------------|---------|---------|-------------|
| 0.                                       | DRAWING NUMBER  | 1  |     | 3        |                     | DESCRIPTION/TITLE          | REV.    | DATE    | COL         |
| $ \_                                   $ | 246R828 X       |    |     |          |                     | Prototype Assembly         | С       | 2/17/66 | ļ           |
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| $\_$                                     | 246R820         | 1  | 2   |          |                     | Stillpot and Rec. Assembly | A       | 10/7/65 | <u></u>     |
|  | <b>263</b> E521 | 1  | 3   |          | <u> </u>            | Hot Trap Assembly          | С       | 2/18/66 |             |
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|  | 142B1691        | 1  | 5   |          | _                   | Stillpot Support           | В       | 2/18/66 | -           |
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#### GENEKAL (26) ELEGIKIC SPACE POWER & PROPULSION SECTION

#### LIST OF DRAWINGS

PAGE  $^2$ OF 4Alkali Metal Purification, Handling and ASSEMBLY TITLE Sampling System, Prototype Loop ASSEMBLY NO. 246R828
Potassium Corrosion Test CONTRACT NO. NAS 3-2547 PROGRAM TITLE Loop Development ISSUE DWG LEVEL ITEM DATE CODE REV. 1 2 3 4 DESCRIPTION/TITLE DRAWING NUMBER NO. 2/17/66 Sodium Purification System 2 246R806 3/11/65 2 Α Dolly Assembly 246R809 3/11/65 Α 2 1 Dolly Frame Assembly 246R808 3/12/65 Α  $2 \mid 1$ 2 Front Panel - Lower 119C2718 3/12/65 Α 2 1 Front Panel - Top 119C2719 3/12/65 2 Left Side Panel - Front 119C2720 3/12/65 Right Side Panel - Front Α 119C2721 3/12/65 2 Right Side Panel - Rear 119C2722 3/11/65 Α  $2 \mid 1$ Left Side Panel - Rear 7 941D525 3/12/65 2 Α Rear Panel - Right 8 119C2723 3/11/65 Α 2 1 9 Rear Panel - Left 119C2724 3/11/65 A ħο Divider Panel 119C2725 3/11/65 A  $_{2}$   $_{1}$ h 1 Top Panel 119C2726 Α 3/11/65 2 12 Piping Assembly 263E517 Α 3/11/65 2 12 Hot Trap Assembly 941D527 3/12/65 2 2 Loop II Charge Tank 142B1615 3/11/65 Α 2 13 Bracket, Ion Pump 119C2717 3/12/65 2 4 Heater Support 142B1619 DISTRIBUTION ISSUED (\*) REVISED THIS ISSUE (V) VENDOR DRAWING NO. REPLACES (C) VENDOR CATALOG NO.

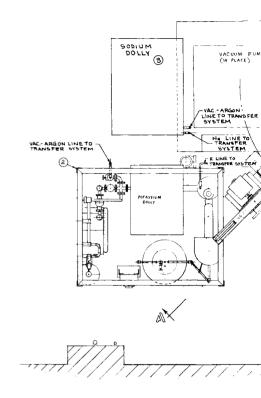
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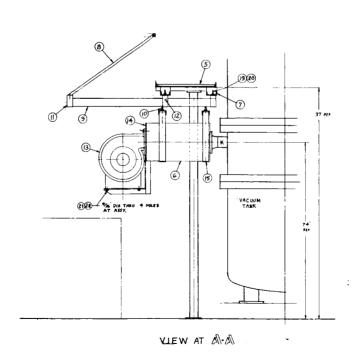
#### SPACE POWER & PROPULSION SECTION

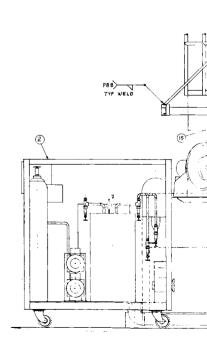
LIST OF DRAWINGS PAGE 3 OF 4Alkali Metal Purification, Handling and ASSEMBLY TITLE Sampling System, Prototype Loop ASSEMBLY NO. 246R828 Potassium Corrosion Test CONTRACT NO. NAS 3-2547 PROGRAM TITLE Loop Development ISSUE DWG LEVEL ITEM CODE REV. 1 2 3 4 DESCRIPTION/TITLE DATE NO. DRAWING NUMBER C 2/18/66 Na & K Transfer Systems 263E731 3 Α 3/11/65 1 246R930 Cabinet 2 Tank, Disposal, Sodium "A" Α 3/11/65 263E734 3/11/65 Cap, Disposal Tank, Sodium 941D754G1 3/11/65 В Body, Disposal Tank SK56131-805  $2 \mid 3$ В 3/11.65 SK56131-807 3 Tube, Disposal Tank 3/12/65 В Well, Thermocouple 165A5723G1 2 5 4/9/64 Level Probe SK56131-806 3 Tank Cnarge, Sodium 941D75<u>5G1</u> 3 C 2/17/65 Well, Thermocouple В 3/12/65 165A5723G2 3/12/65 Plate В 165A5724 Tee\_\_\_\_ 142B1784 6 3/12/65 Tank, Disposal, Potassium "B" 3/11/65 263E734 3/11/65 941D754G2 Cap, Disposal Tank, Potassium 2 В 3/11/65 Body, Disposal Tank SK56131-805 2 3/11/65 SK56131-807 Tube, Disposal Tank В 2 Well, Thermocouple В 3/12/65 165A5723G1 2 4/9/64 SK56131-806 Level Probe 3 С 2/17/65 941D755G1 Tank, Charge, Potassium 2 3/12/65 165A5723G3 Well, Thermocouple B DISTRIBUTION ISSUED CODE: (\*) REVISED THIS ISSUE REPLACES (V) VENDOR DRAWING NO.

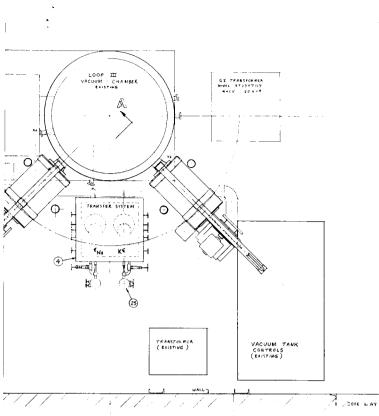
### GENERAL ED ELECTRIC SPACE POWER & PROPULSION SECTION

|      |   |  |  |          |  |   | PAGE   | 4 OF                | 4 .         |
|------|---|--|--|----------|--|---|--|---------------------|-------------|
| ACC  | Alkali Me                               | eta.   | l P  | ur       | ifi<br>m.  | cation, Handling and<br>Prototype Loop ASSEMBLY NO. 246 | R828   |                     |             |
| A33  | OGRAM TITLE                             | Po   | tas  | si       | um   | Corrosion CONTRACT NO. NA                               |  | 547                 |             |
| PRO  | OGRAM TITLETest                         |  |  |          |  | contract No. NA   | ~ ~ ~  | <del></del>         |             |
| ITEM | DRAWING NUMBER                          | DW<br>1  | G L  |          | <u>L</u>   | DESCRIPTION/TITLE                                       | REV.   | ISSUE<br>DATE       | CODE        |
| NO.  | DRAWING NUMBER 941D536                  | H  | -  | 3        | -  |   | В  | 2/17/66             |             |
|      |   | 5  | $\mid \cdot \mid$                                | _        | $\dashv$   | High Vacuum Sampling System                             |  | 10/1/65             |             |
|      | SK56151-778                             | 6  |  |          |  | Spatial Arrangement of Purification                     |  | 10/1/65             |             |
|      | GRECI DI GCC                            | 7  | H  |          |  | and Handling Systems                                    | <b></b>  | 2/28/64             |             |
|      | SK56131-766                             | 7  | H  |          | $\dashv$   | Nak Sampling Device                                     | <del> </del>                                     |                     |             |
|      | 941D535                                 | 4  | $\mid \cdot \mid$                                |          |  | Potassium System Schematic                              |  | 11/10/64<br>5/19/65 |             |
|      | 941D814                                 | 8  |  |          |  | Sodium System Schematic                                 | A  | 3/19/03             |             |
|      | · · · · · · · · · · · · · · · · · · ·   | <del>                                     </del> | H  |          |  |   | <b>†</b>   |                     |             |
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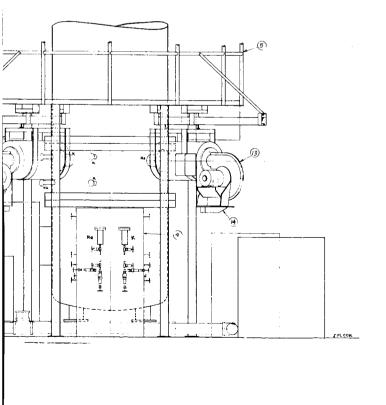






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|     | NO.             | DESCRIPTION ON NODE.                    | 200  | T-  | 2  | , | 14  | - | -  |                             | PATE      | -         |
| 1   |                 | ASSY                                    | 1    | T . | Γ  | 1 |     | Ι | IA | TITLE CHANGE DOF            | 1000      | OCKU      |
| 2   |                 | POTASSIUM DOLLY ASSY                    | _    |     |    | _ | _   | _ | _  | ITEM 8 WAS CHANNEL 4" @ 8.2 | # 10·7·45 | PA. ELLIS |
| 3   | 24CR 80661      | SODIUM PURIFICATION DOLLY               |      | 1   | _  |   |     | Ī | n  | II FT LONG.                 | 1         | 1         |
| 4   | 263 E 73/GI     | Na & K TRANSFER SYSTEMS                 |      | T   |    |   |     | 1 | В  | 17 FMS 16, 17,18, 23 & 24   | 1         | 1         |
| 5   | 263 € 51461     | CAT WALK                                |      | 1   |    |   |     | 1 | {  | CHANGED PER CHA 0193        | ł         | ł         |
| 6   |                 | E.M. PUMP G.E.                          |      | 2   |    |   |     | 1 | ١_ |                             | +-        |           |
| 7   |                 | CHANNEL & @ 8.216,                      |      | AR  |    |   |     | Ť | C  | GENERAL CHANGE PER CHOS     | ᄩᇎ        | SCALL     |
| 8   |                 | ANGLE I'AI' A 18"                       | -    | AR. |    |   |     | 1 | _  |                             |           |           |
| 9   | (SEE NOTE 1)    | R-W TRACK # 232 - 5 FT L4.              |      | 2   |    |   |     | 1 |    |                             |           |           |
|     |                 | R-W TRUCK CATE 235                      |      | 4   | _  |   |     | 1 |    |                             |           |           |
| 11  | ( SEF HOTE I)   | END BRACKET CAT . 17 . 232              |      | 4   |    | _ |     | Ī |    |                             |           |           |
| 12  | (SEE HOTE!)     | CENTER BRACHET CAT . 18 4232            | -    | 4   |    |   |     | 1 |    |                             |           |           |
| 13  | (SEE NOTE 2)    | BLOWER CAT # 13-6-1                     |      | 2   |    |   |     | 1 |    |                             |           |           |
| 14  | 941054861       | MOUNTING BRACKET                        |      | 2   |    | _ |     | 1 |    |                             |           |           |
| 15  | 119 - 276161    | SUPPORT E M PUMP                        |      | 4   |    | _ |     | ı |    |                             |           |           |
| 76  | 1428768261      | CORNER BRACKET                          | ==   | 17  |    |   |     | t |    |                             |           |           |
| 17  | 7428169341      | BRACKET                                 | =    | 1   |    |   | _   | 1 |    |                             |           |           |
| 18  |                 | PAPARSTON SHIELDS No.                   |      | -   | -  | _ | _   | Ì |    |                             |           |           |
| 19  | T               | THREADED ROD-STL. %-11 + 4'Lg.          |      | 18  |    |   | -   | t |    |                             |           |           |
| 20  |                 | NUT %a-II                               |      | 32  | _  |   |     | 1 |    |                             |           |           |
| 21  |                 | COLT HEAMD. No - 16 HC KILLS            |      | 4   |    | _ |     | t |    |                             |           |           |
| 22  |                 | NUT HEX VA-16 NC                        | -    | 7   | _  | _ |     | 1 |    |                             |           |           |
| 23  |                 | DOT HER HO TO 15 HE SILE.               |      | 12  | _  | _ |     | 1 |    |                             |           |           |
| 24  |                 | NUT HEA IZ 15 WE                        | -    | 72  | _  |   |     | 1 |    |                             |           |           |
| 25  | 941053667       | HIGH VACOUM SAMPLING SYSTEM             | -    | 2   | 1  |   |     | 1 |    |                             |           |           |
|     |                 |   | _    | 1   | _  | _ |     | í |    |                             |           |           |
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| _   | <del>_</del>    | † · · · · · · · · · · · · · · · · · · · |      | +   | +- | _ |     | 1 |    |                             |           |           |

PLAN



- NOTES:

  1- RICHARDS WILCOX MFG. CO., AURORA, ILL.
  2- WM. W. MEYERS & SONS INC., SKOKIE, ILL.

  3- PAINT ALL STRUCTURAL MEMBERS & BRACKETS I COAT
  ZINC OXIDE PRIMER & 2 COATS DUPONT \*GI HORIZON
  GRAY
  - 4-SYSTEMS SCHEMATIC DWG. 9410 535 FOR REP.ONLY,

R 246 R 828 | C

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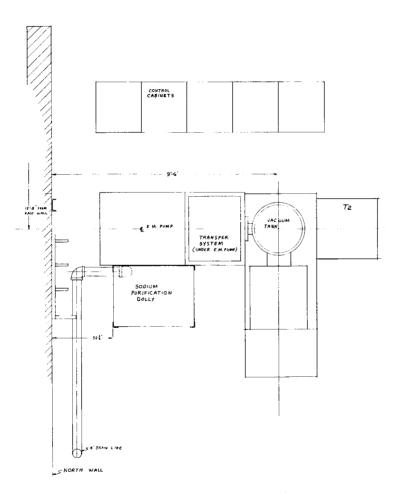
Jame 2:17.51 PURIFICATION, HANDLING

JAME PROTOTYPE LOOP OEMERAL DELECTRIC EVENDALE CONTRACT \* NAS. J. 2547 R 246R828

VACUUM TRANSFER
TRANSFER
AND "S TOBING
TOBETHER AFFER
LOCATING DOLLY PLAN VACUUM TANK 0 0 <del>0</del> 0 ION PUMP -ROUGHING PUMP POWER-NORTH WALL BLD 3/4 ELEVATION

92-1

| MEM | IDENTIFICATION | DESCRIPTION OR NAME          | me  |     |    | 0.6     |
|-----|----------------|------------------------------|-----|-----|----|---------|
|     | 90.            |                              | 1== | ٠.  | 1. | -       |
| 1   | İ              | ABSY                         | ı   | , x | 1. | I . I . |
| 2   | 246R 805       | LOOP & SODIUM TRANSFER SYSTE | At  | 1   | Γ" |         |
| 3   | 246 R 806 .    | LOOP IS SODIUM PURIFICATION  | 1   | TI  |    |         |
|     |                | SYSTEM                       |     | 1   | _  | -       |

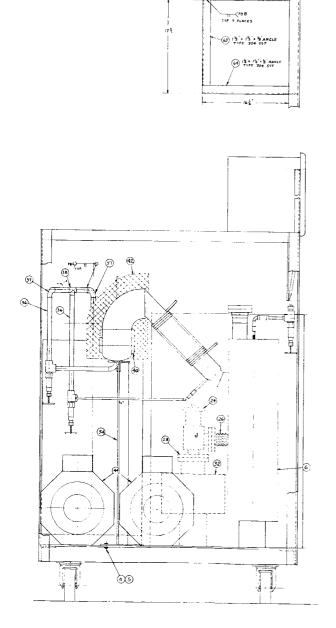


LOCATION PLAN LOOP II BLD. 314 CELL 1

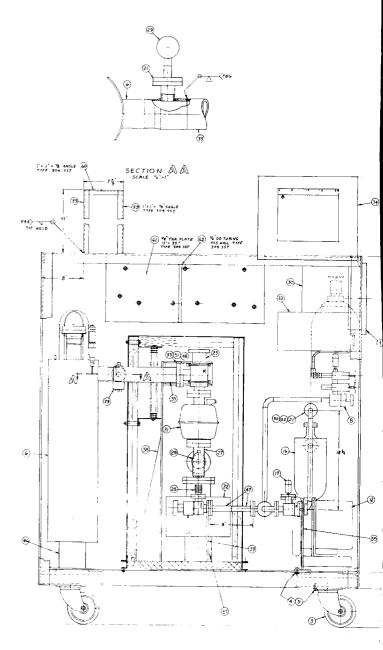
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REAR VIEW

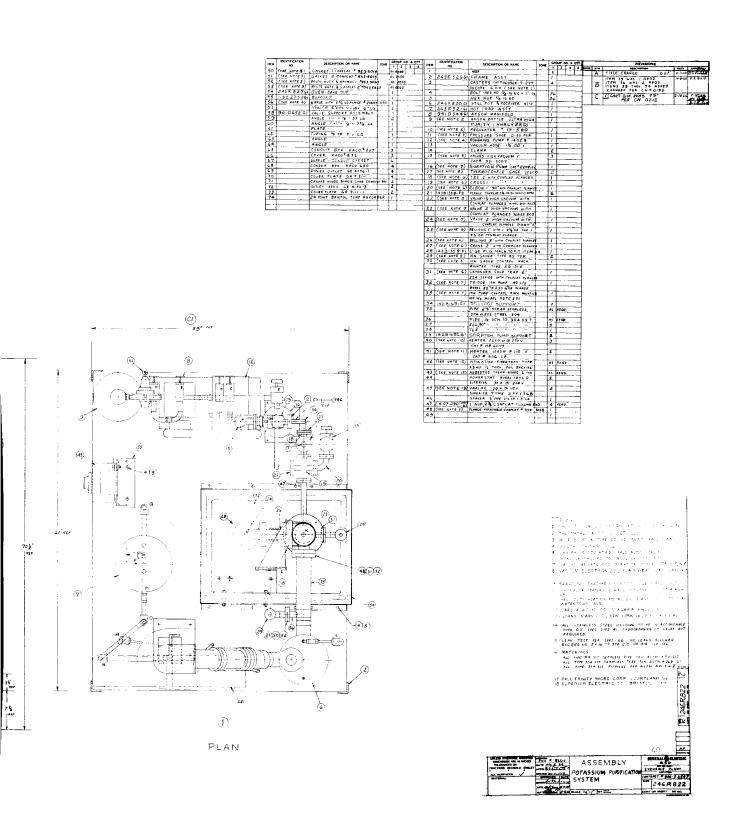
LEFT SIDE ELEVATION

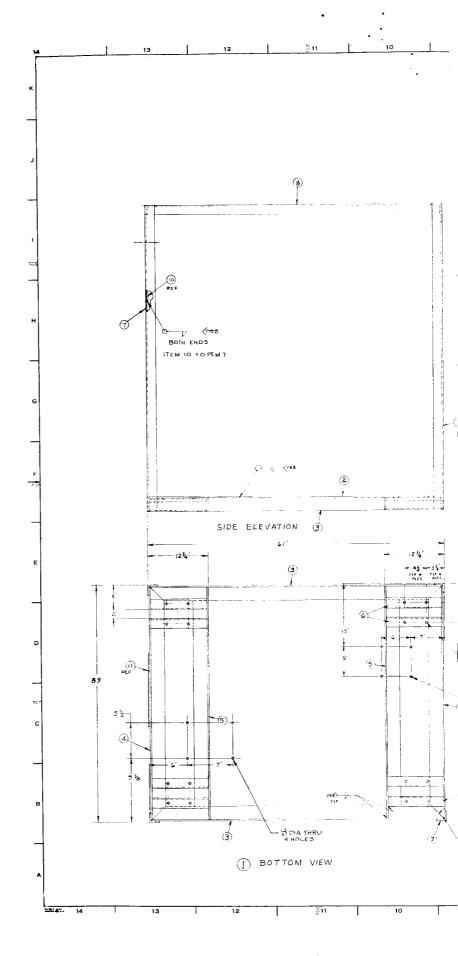


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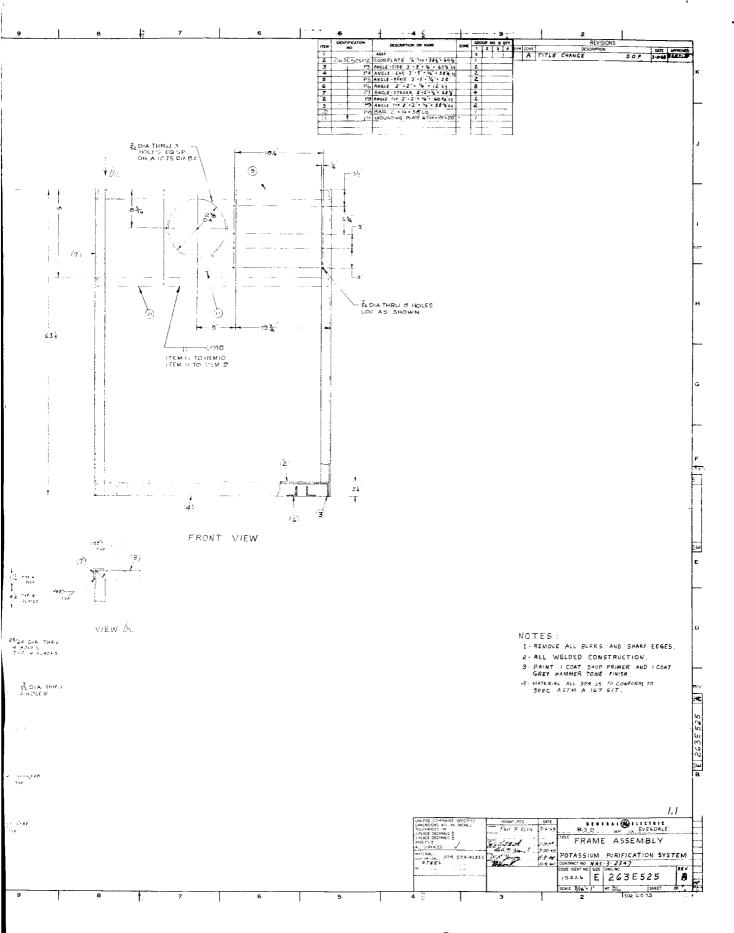


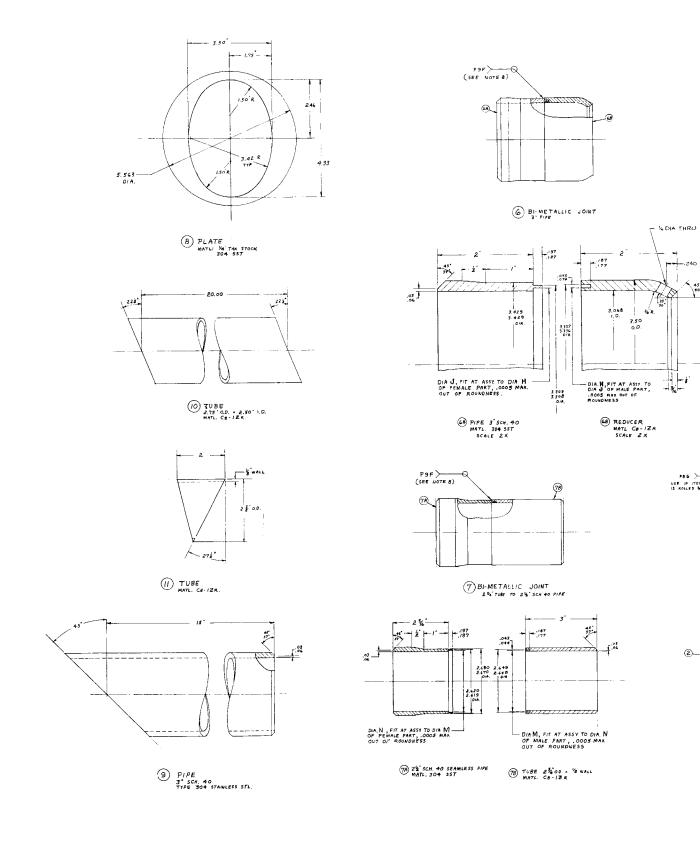
RIGHT SIDE ELEVATION



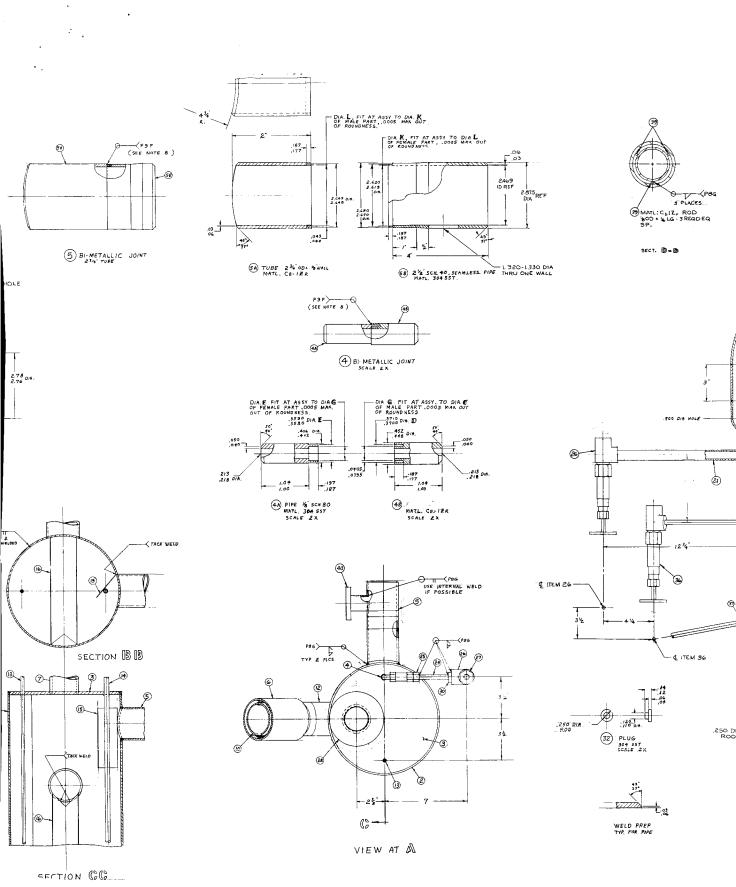


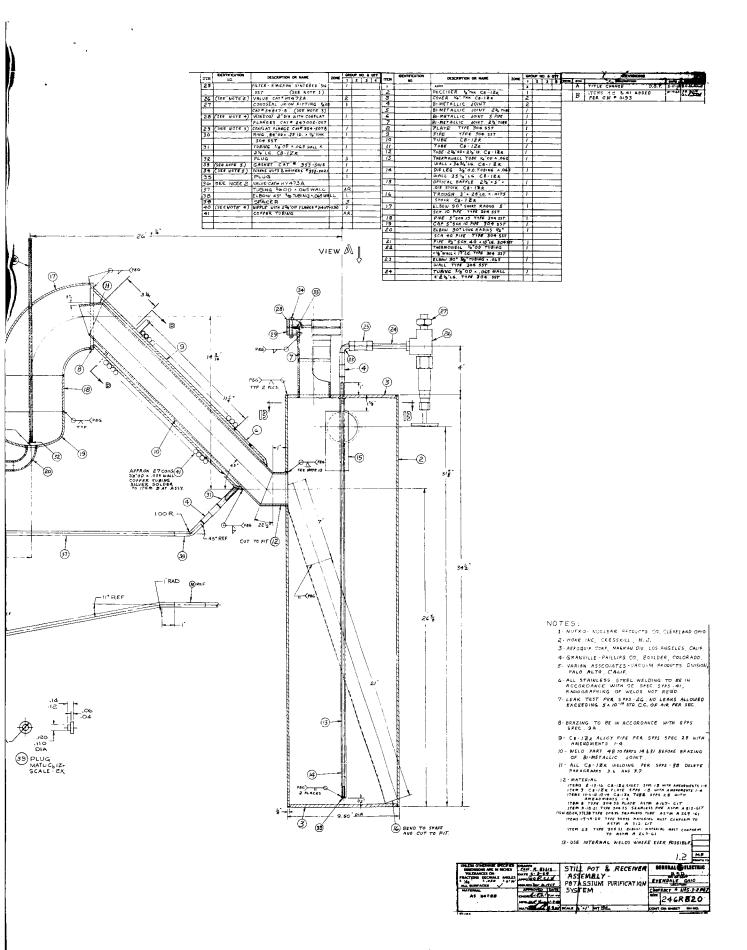
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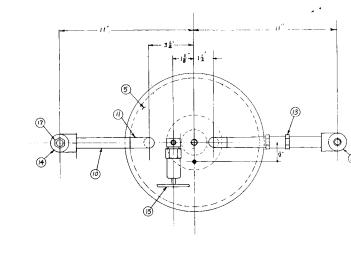


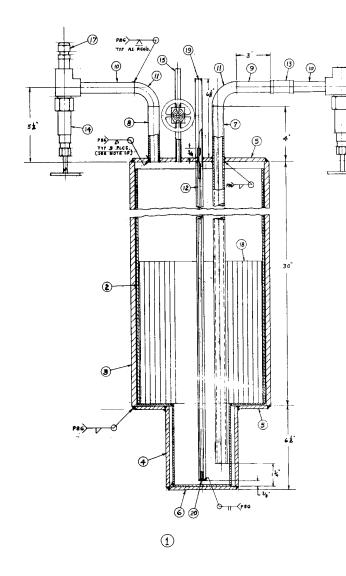


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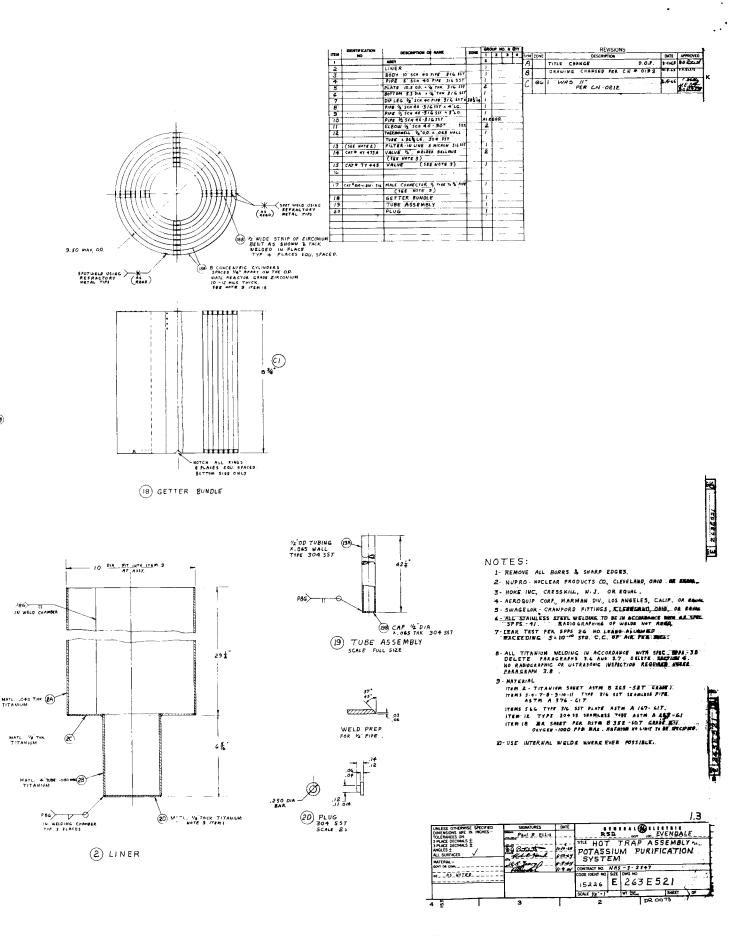


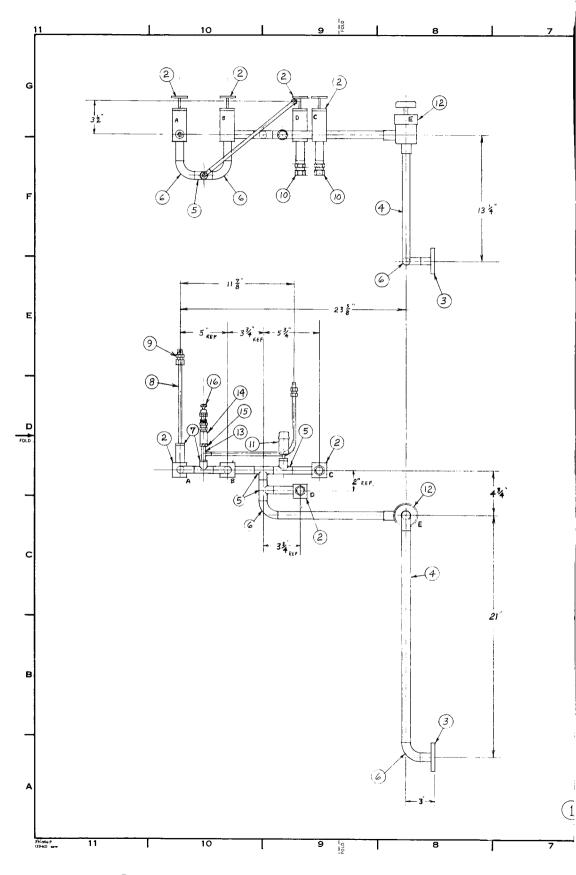


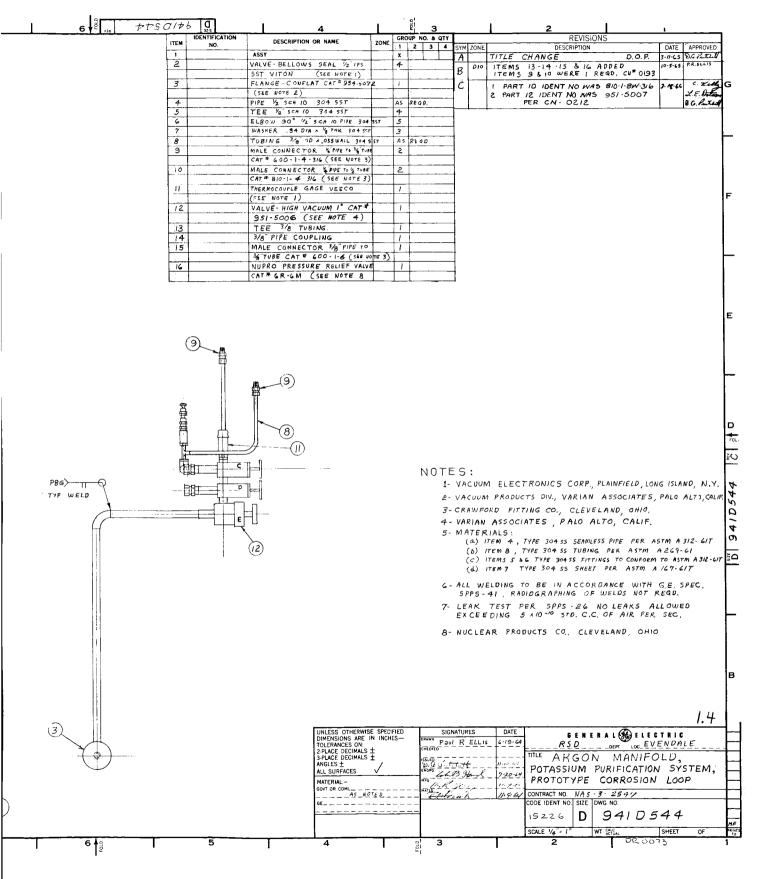


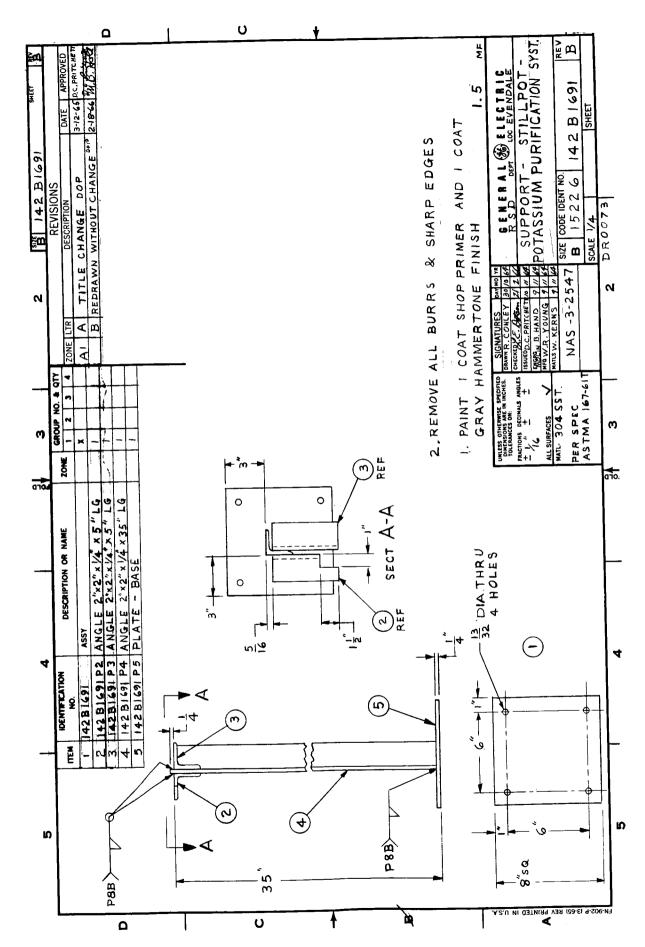


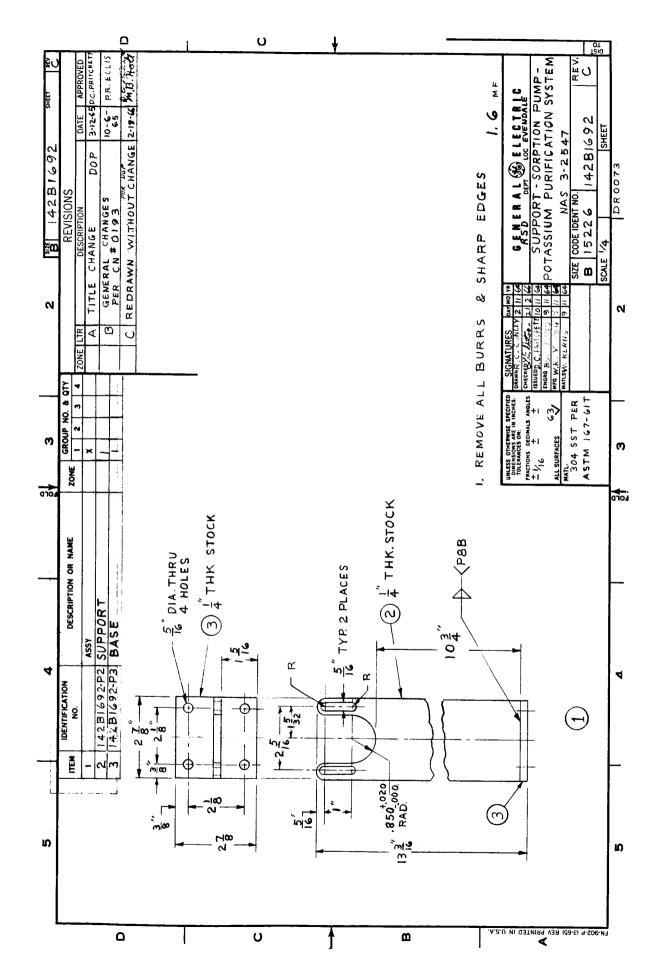
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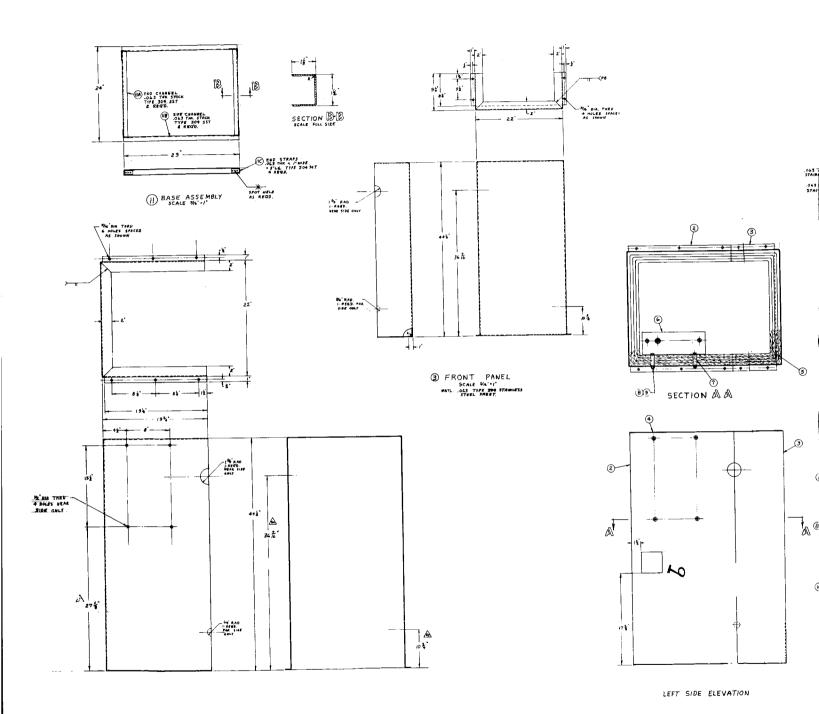




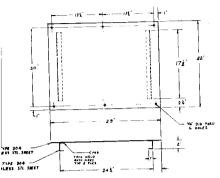


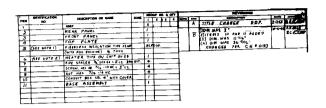


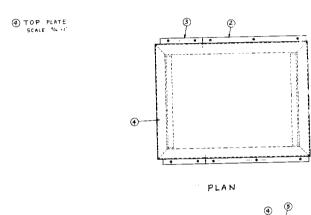


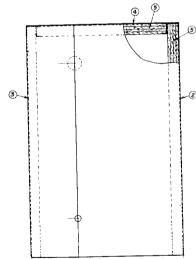


@ REAR PANEL









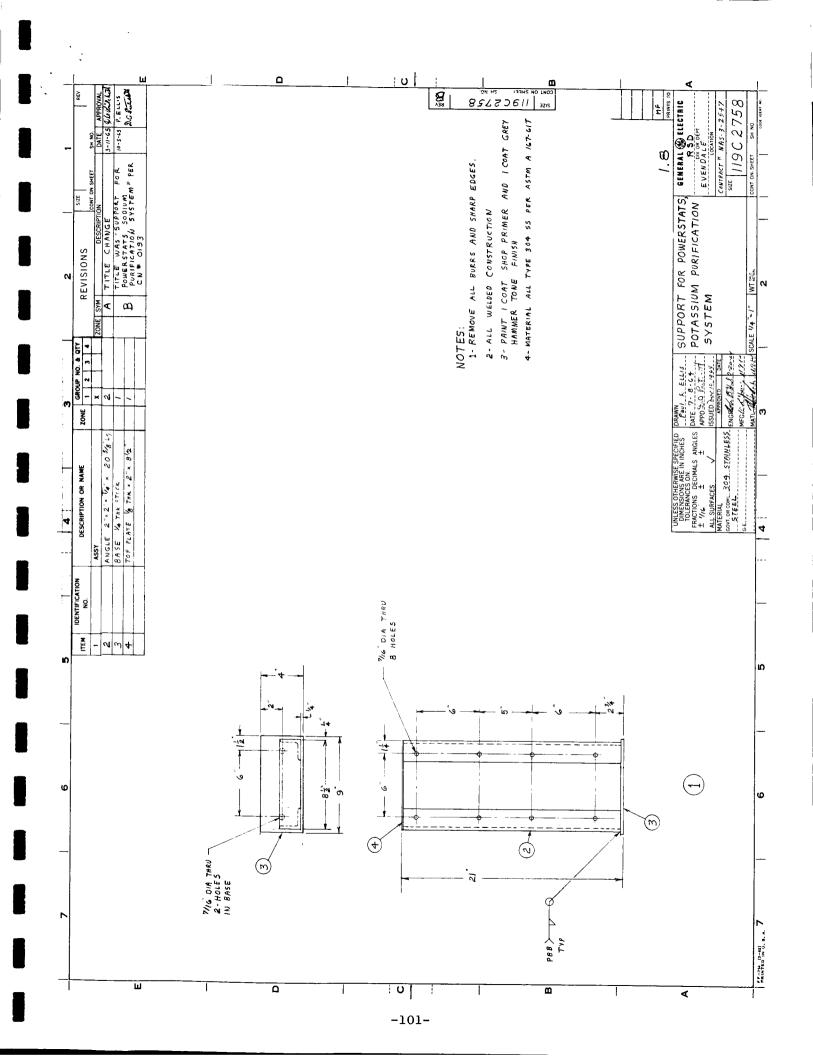
RIGHT SIDE ELEVATION

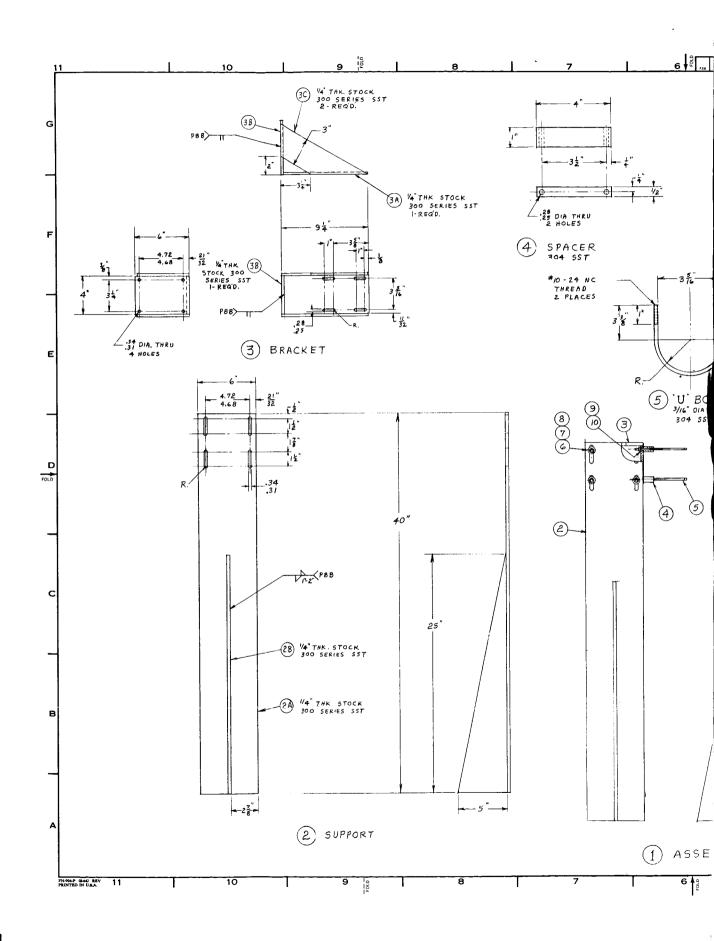
- NOTES: 1-CARBORUNDUM CO., NIAGARA FALLS N.Y OF LOUAL L-CHARDHEUNUUM CO. NIAGRAR FAILS NY OFISAN.
  2-CHROMALON HEATERS - EDWIN L. WIEGAND CO.,
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  TO ASTM A 167-61T.
- TO CONFORM

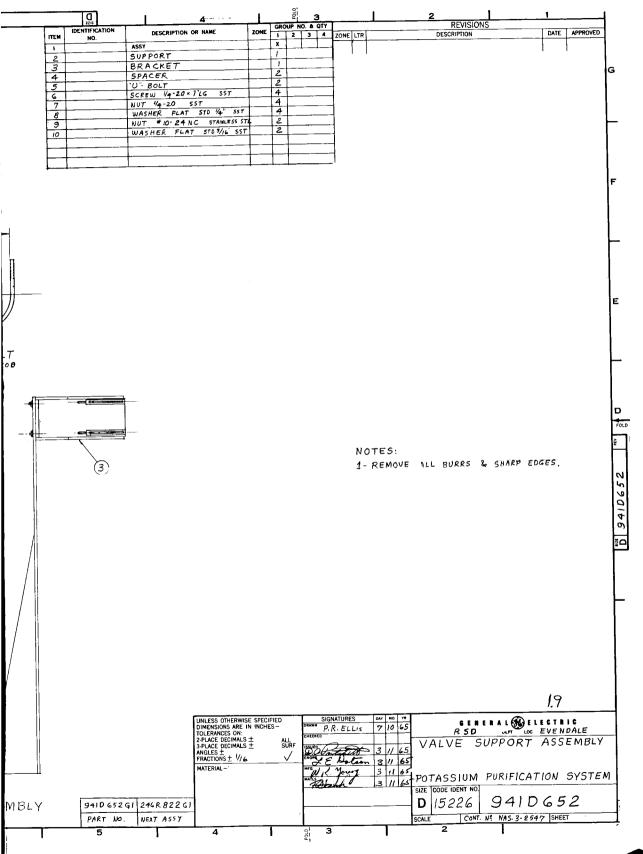
| (1) | ASSEMBLY |
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FRONT VIEW

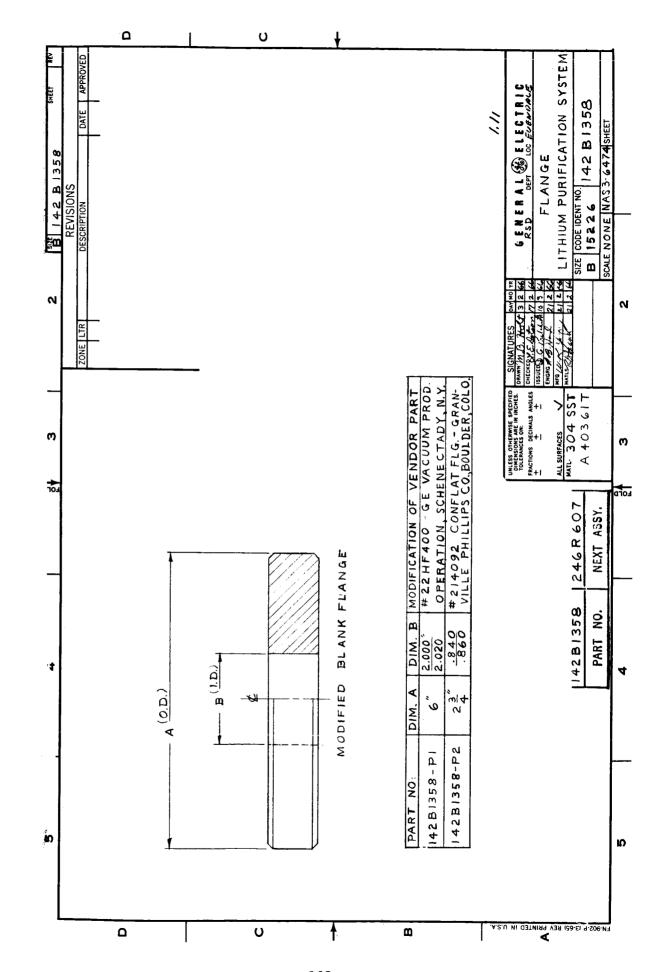
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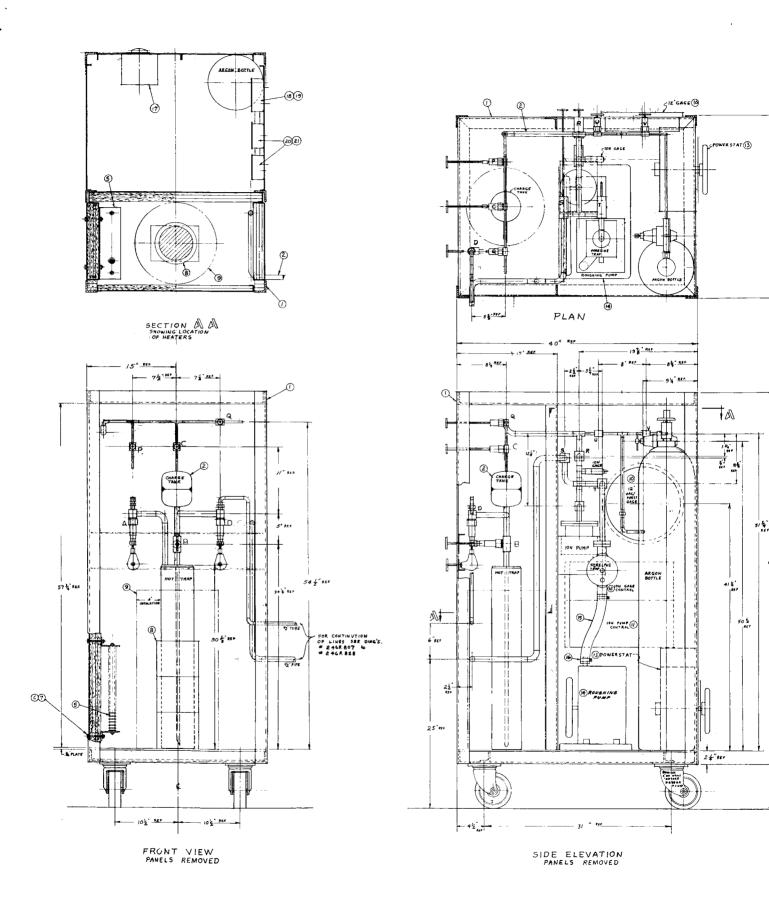




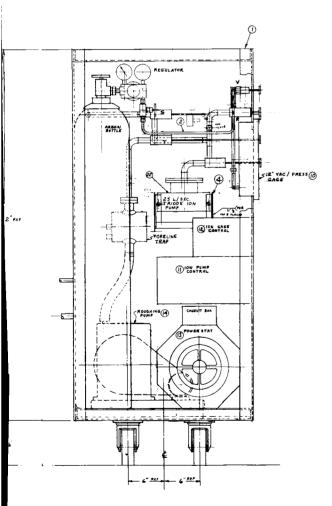


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| 1 -    | <del></del>      | ASSY                            |            | ╚              | Т   | $\Box$ | 7   | 1            | A     |          | HANGE       | D.O.P. |       | 3.0.C.C    |
|        | 246 R 809 GI     | DOLLY ASSEMBLY                  |            | IJ.            | L   |        |     | -            | 8     | L ITEM ( | , ADDED + £ | ETCEDI | 2-174 | X E. A.    |
| 7      | 243 E 517 GI     | PIPING ASSEMBLY                 |            | Ш              | L   |        |     | 1            | 1     | 3 ADDED  | ADDED #2    | 290100 | 1     | mang       |
| 4      | 119C 271761      | BRACKET                         | L          | 1              | L   |        |     | 1            | 1     | T VDDFD  | ERCN-03     | 11     | 1     |            |
| 5      | (SEE NOTE 1)     | HEATER THE OF CAT" OV-25        | L          | 1              | 1.  |        |     | <del>-</del> | _     |          |             |        |       |            |
| -2     | 1                | BOLT THE 14 HC . 3 LG . HES MD. | L          | 16             | 1   |        |     | 1            |       |          |             |        |       |            |
| 7      |                  | NUT - HEX 7/4-14 NC             |            | 6              | ┸   |        |     | 1            |       |          |             |        |       |            |
| -      | †"·              | HEATER                          | L_         | 12             | -   |        |     | 4            |       |          |             |        |       |            |
| 9      | (SEE HOTE 2)     | INSULATION-FIBERFRAN THE AS     | WF         | ) AS           | 14  | 9      |     | 4            |       |          |             |        |       |            |
| ~      |                  | VE THICK WITH FOIL BACKING      | L          | ┺              | 1   |        |     | 4            |       |          |             |        |       |            |
| 10     | (SEE NOTE 3)     | GAUGE . FLISH MO-HTED . SIZE IZ |            | 1              | ┸   |        | _   | 1            |       |          |             |        |       |            |
|        |                  | 0- 30 PSIA.                     | $\perp$    | ₽.             | 1   |        |     | 4            |       |          |             |        |       |            |
| 11     | SEE HOTE 4)      | ION PUMP CONTROL - RACK MOUNT   | L_         | 11             | 1   |        | _   | 1            |       |          |             |        |       |            |
|        | 1                | # 22TC ZOI                      | <u>L</u>   | 1_             | 1   |        | _ ~ | 1            |       |          |             |        |       |            |
| 12     | (SEE DOTE 4)     | ION GAGE CONTROL -RACK BOU      | ·          | 11             | 1   |        |     | 4            |       |          |             |        |       |            |
| _      | 1                | + 22GC100                       | <u>Ц</u> . | _              | 1   |        |     | 4            |       |          |             |        |       |            |
| 13     | +                | POWER STAT MODEL 1256 D         | 1          | 1              | 1   |        |     | 1            |       |          |             |        |       |            |
| -      | <del> </del>     | 18 AMP 0-1704 0+7947            | 1_         |                | 1   |        |     | 4            |       |          |             |        |       |            |
| 14     | (SEE NOTE 5)     | ROUGHING PUMP # 1402            | 1          | 11             | 4.  |        | -   | 4            |       |          |             |        |       |            |
| 15     | 1                | VACUUM HOSE 142 OD.             | L          |                |     | 140    |     | ال           |       |          |             |        |       |            |
| 16     |                  | CLAMP                           | L_         | 12             | 1   |        |     | 4            |       |          |             |        |       |            |
| 17     | (SEG MOTE G      | POWERSTAT TYPE SPHIZE           | I          | 14             |     |        |     | _1           |       |          |             |        |       |            |
| 10     | CSEE NOTE T      | 44 SQ. BOR RACO # 247           |            | 1              | Т   |        |     |              |       |          |             |        |       |            |
| 79     |                  | COVER RACO # 832                | 1          | Τ.             | Ι.  |        |     | 1            |       |          |             |        |       |            |
| 20     |                  | HAMPY BOX RACO * CCO            | $I \equiv$ | 2              |     |        |     | -1           |       |          |             |        |       |            |
| 21     |                  | - COVER RACE SEC                | 4          | 2              | . L |        |     | .1           |       |          |             |        |       |            |
|        | (SEE NOTE 4)     | TRICOL ION PUMP, + EETPEOE      | T          | 77             | Т   |        |     | 1            |       |          |             |        |       |            |



REAR VIEW

- NOTES:

  1 CHROMALOX HERYERS EDWIN L WIEGAND CO, PITTS BURG 8, PA. OR EQUAL

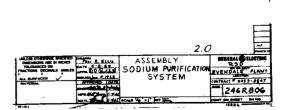
  2 CARBORUNCUM CO, NIAGARA FALLS NY OR EQUAL

  3 MEISE BOURDON TUBE CO, INC., NEW TOWN, CONN., OR EQUAL

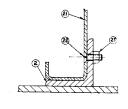
  4 VACUUM PRODUCTS OPERATION, GENERAL ELECTRIC CO, SCHEMECTADY S, N.Y.

  5 WELSH CHICAGO ILL OR EQUAL

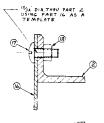
  - 6. SUPERIOR ELECTRIC CO., BRISTOL, CONN. OR EQUAL
  - 7- GENERAL ELECTRIC SUPPLY CO., CINTI., OHIO



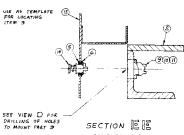
104-2



SECTION COCO

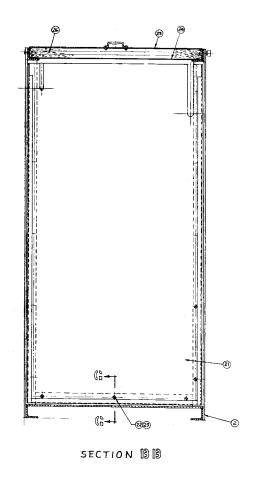


SECTION IF



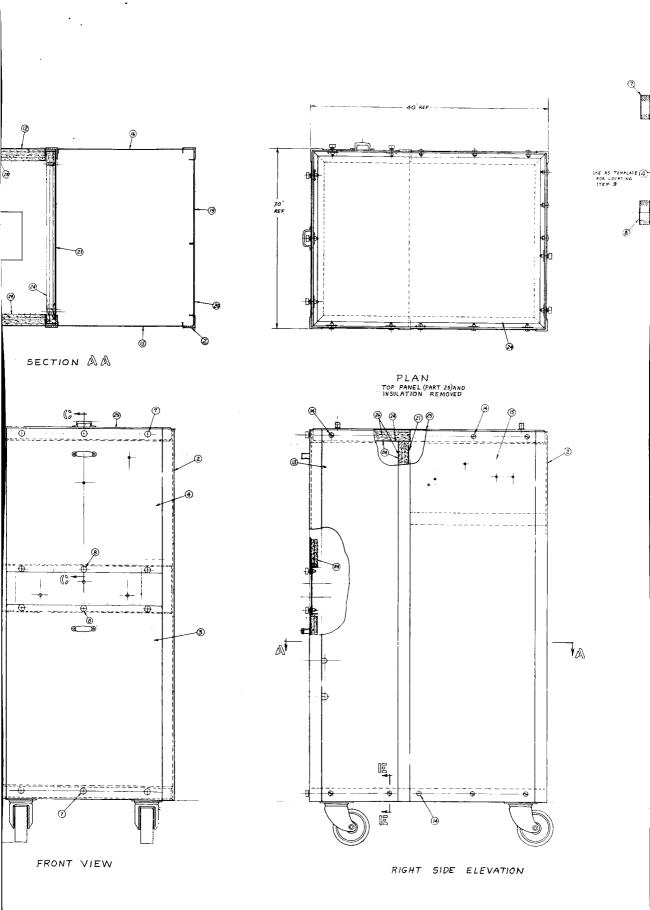
r 1908

SECTION EE

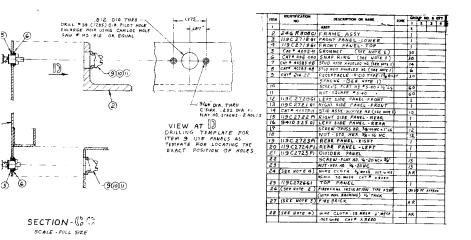


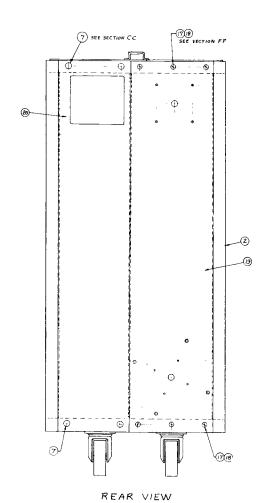
[3] **6** 13.

LEFT SIDE ELEVATION



105-2





## NOTES:

- 1- CAMLOC FASTENER CORP., PARAMUS, N. J. OR EQUAL
- 2- CARBORUNDUM CO., NIAGARA FALLS, N.Y. OR EQUAL 3- A.P. GREEN FIREBRICK CO., MEXICO, MO. OR EQUAL
- 4- MSMASTER CARR SUPPLY CO., CHICAGO, ILL. OR EGUAL

EVERDAL PLANT

CONTRACT PART

246R809 ASSEMBLY SODIUM PURIFYCATION SYSTEM DOLLY

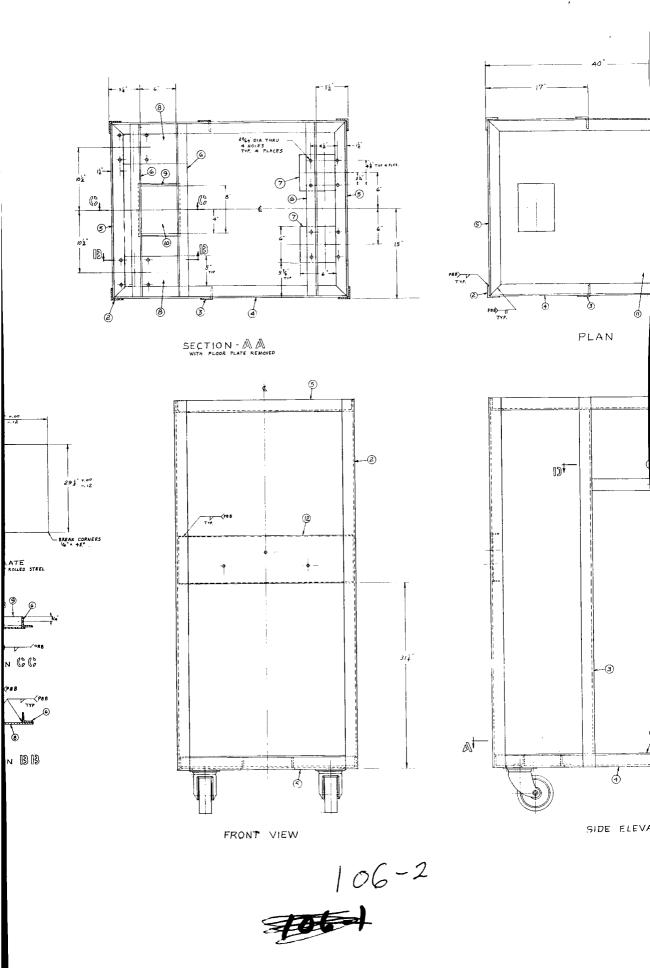
5, 5, 6, 1

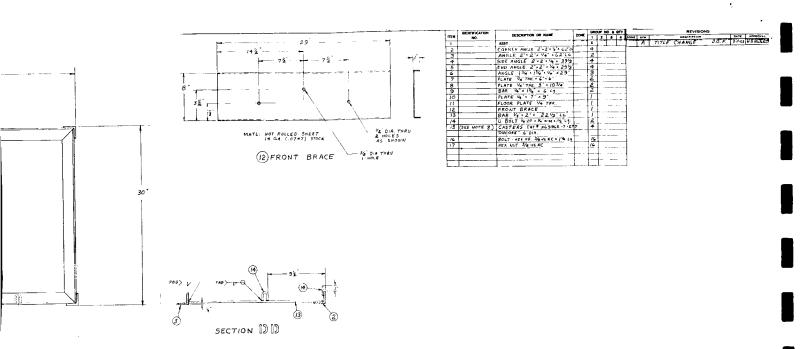
FLOOR

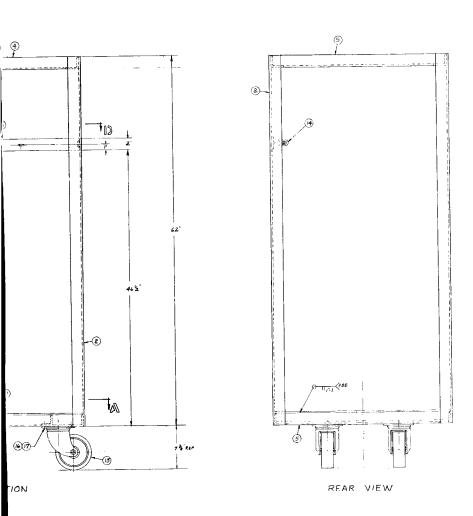
SECTI



SECT







## NOTES:

- 1- REMOVE ALL BURRS AND SHARP EDGES
- 2- ALL WELDED CONSTRUCTION
- B. THE BASSICK CO., BRIDGEPORT 5, CONN. OR EQUAL.
  4. PAINT I COAT SHOP FRIMER AND I COAT GREY HAMMER TOWE PILITSM.

MAGES COLOR FOR FILES SOUTH PURIFICATION SYSTEM GENERAL SELECTRIC

RSD

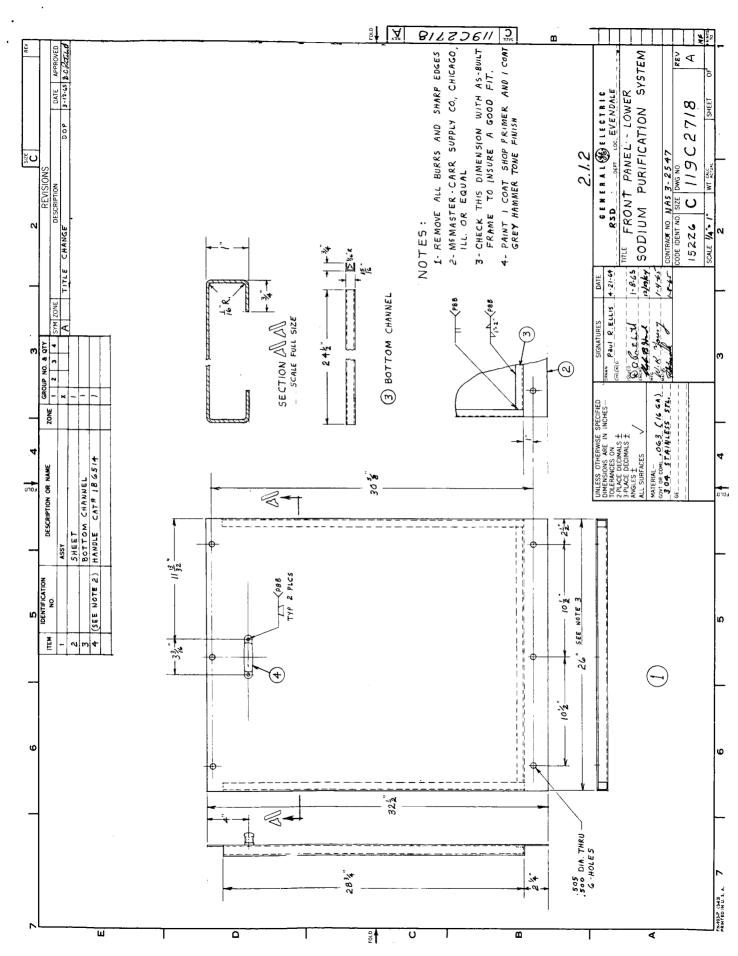
RVEN DIVISION OF ANT

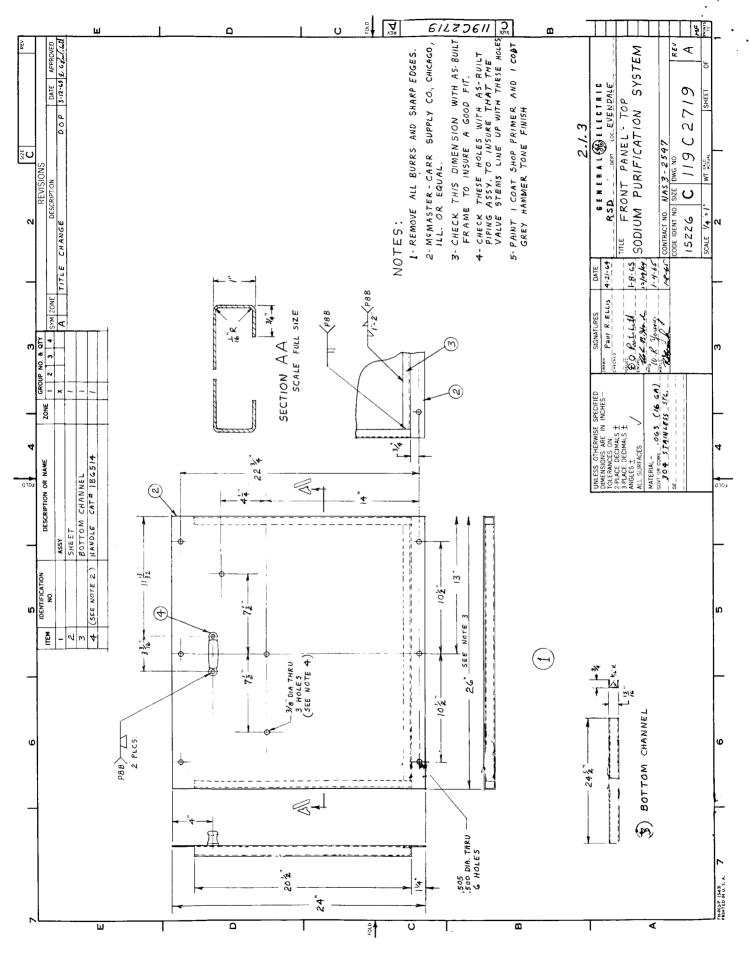
CONTACT S MASS-2547

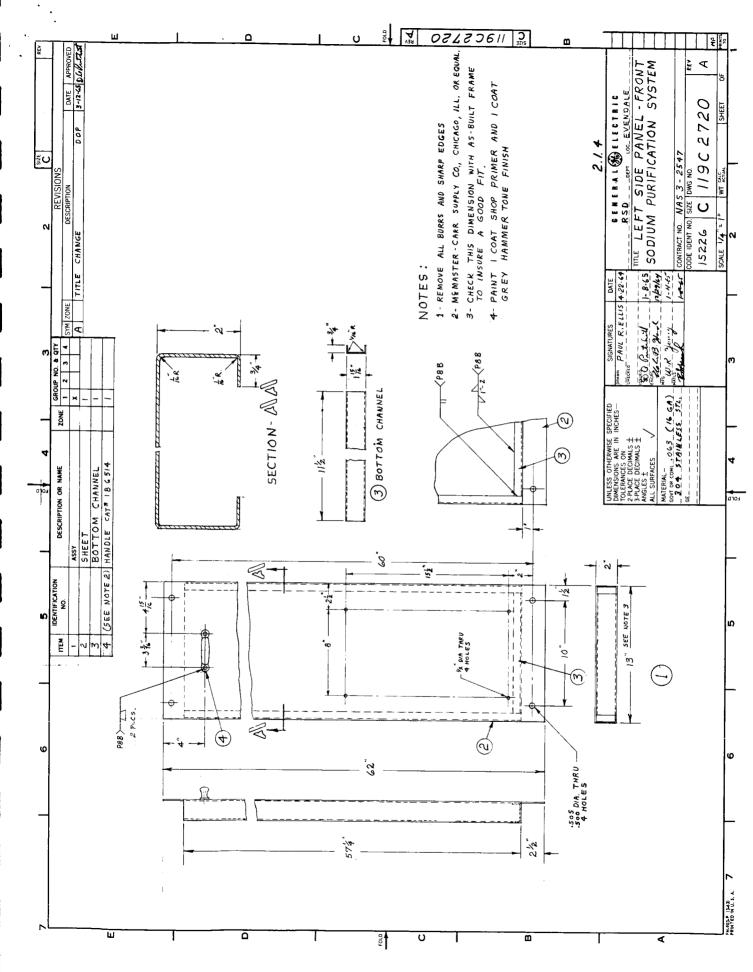
246R 808

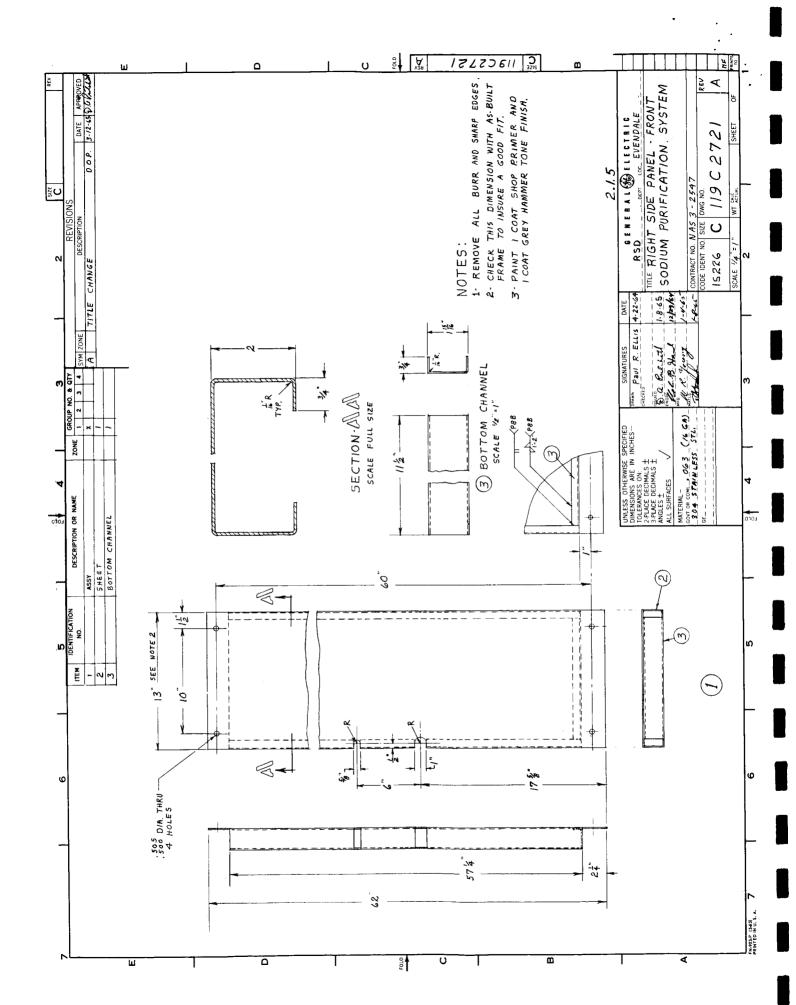
CONTACT S MASS-2547

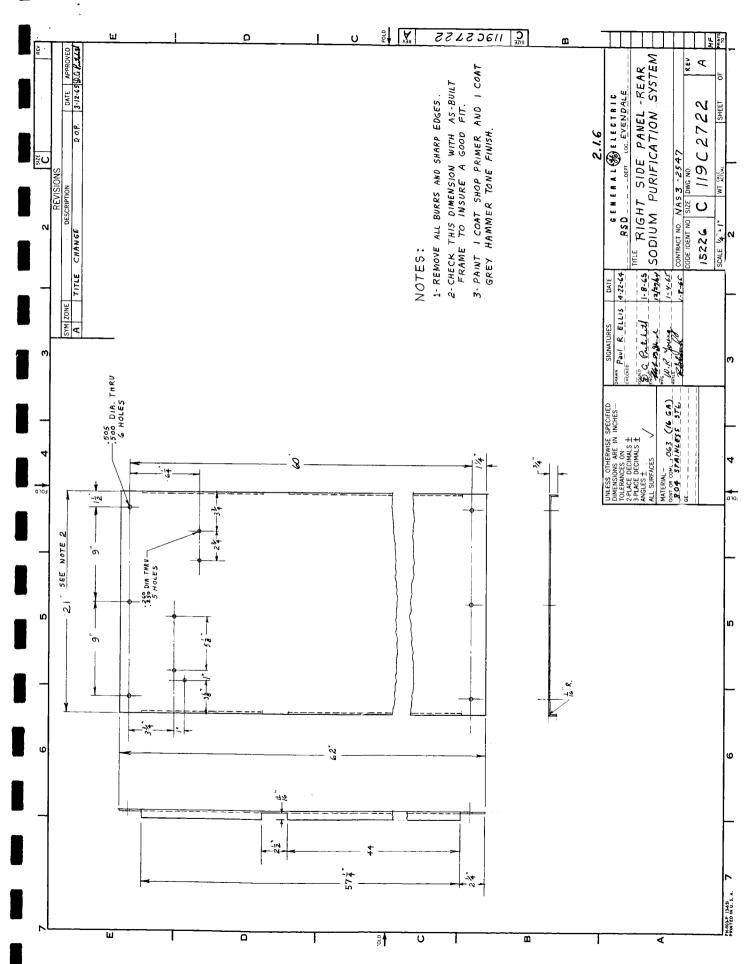
-106-106-3

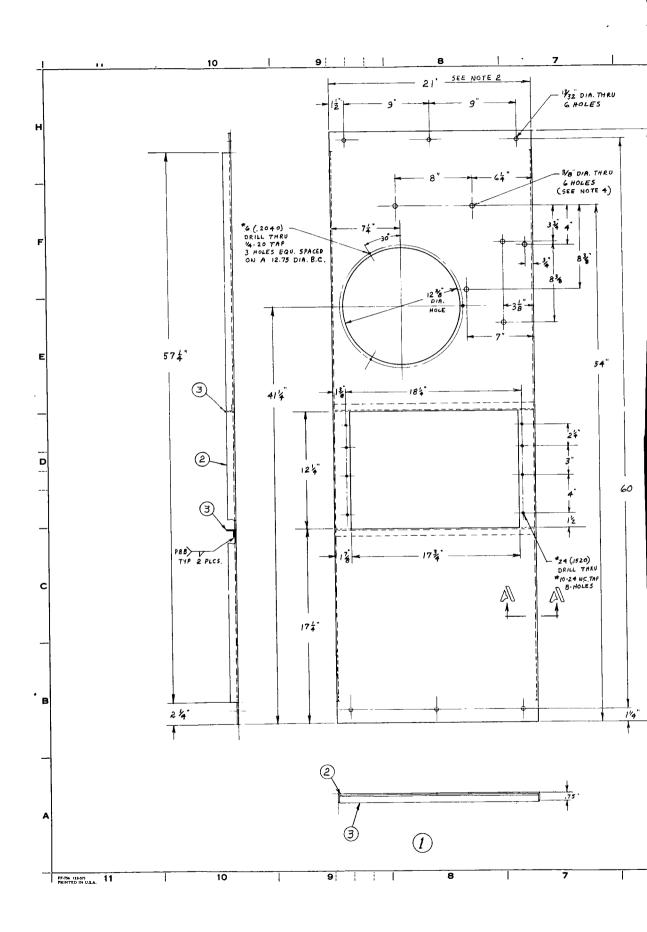


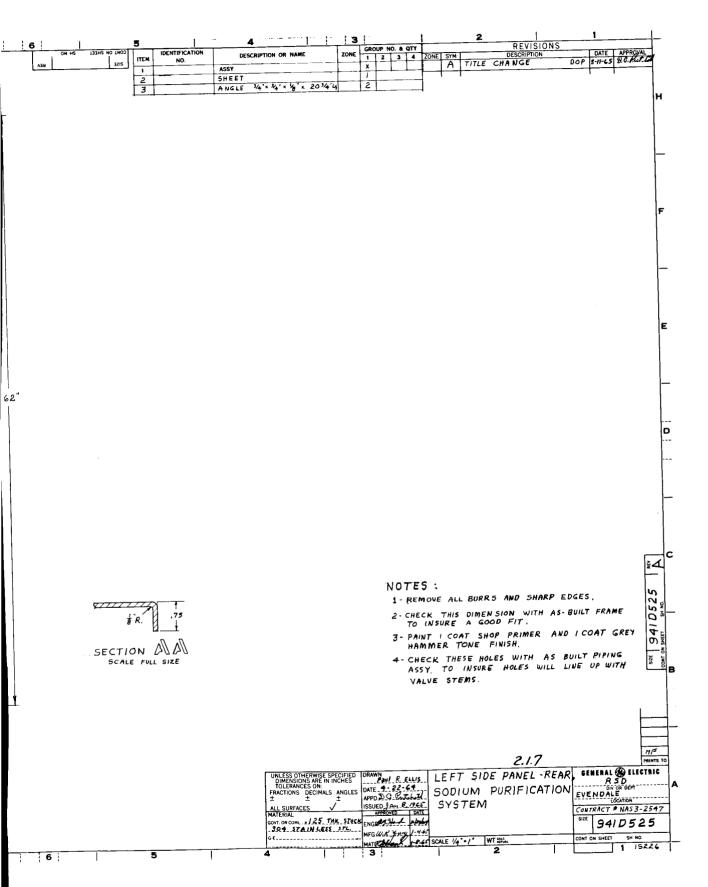


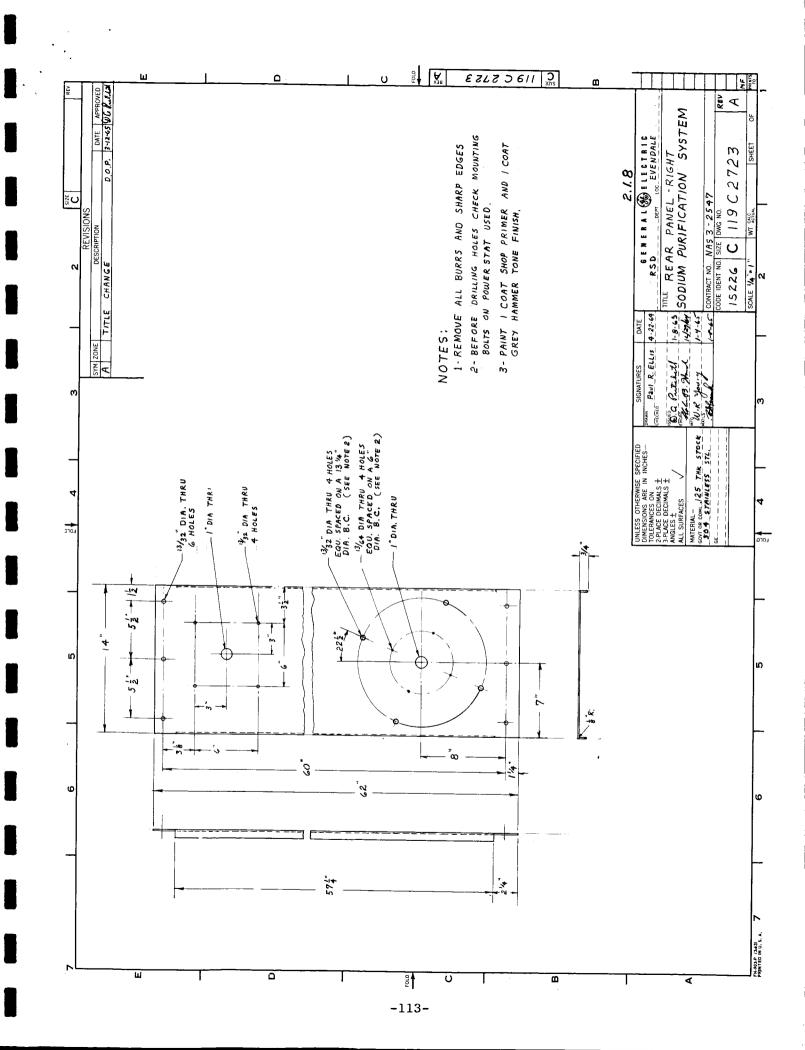


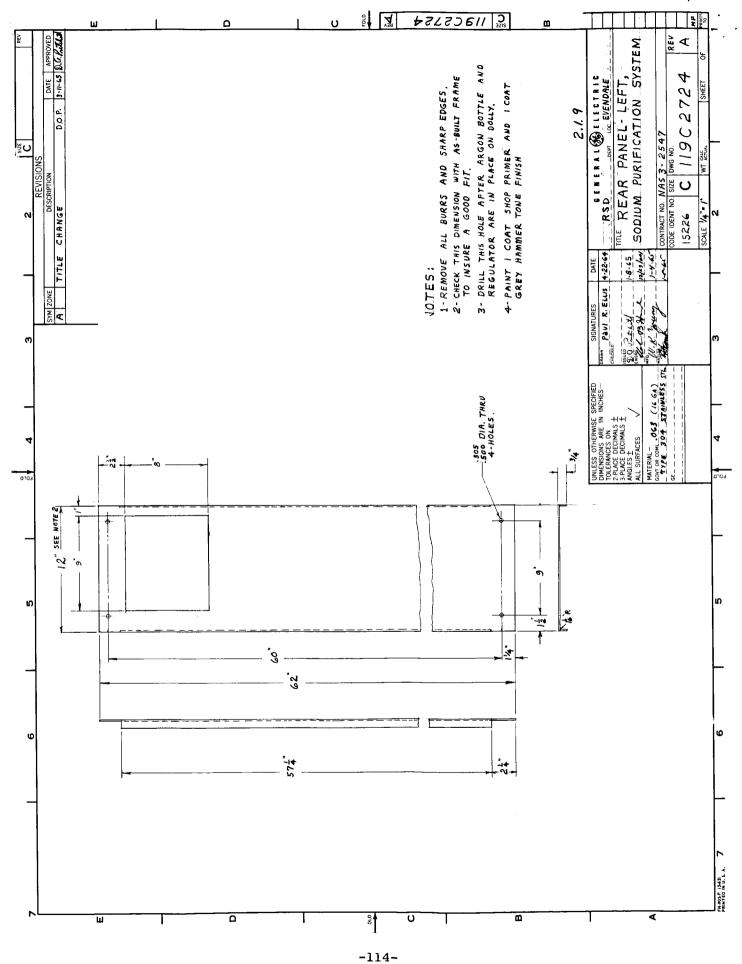


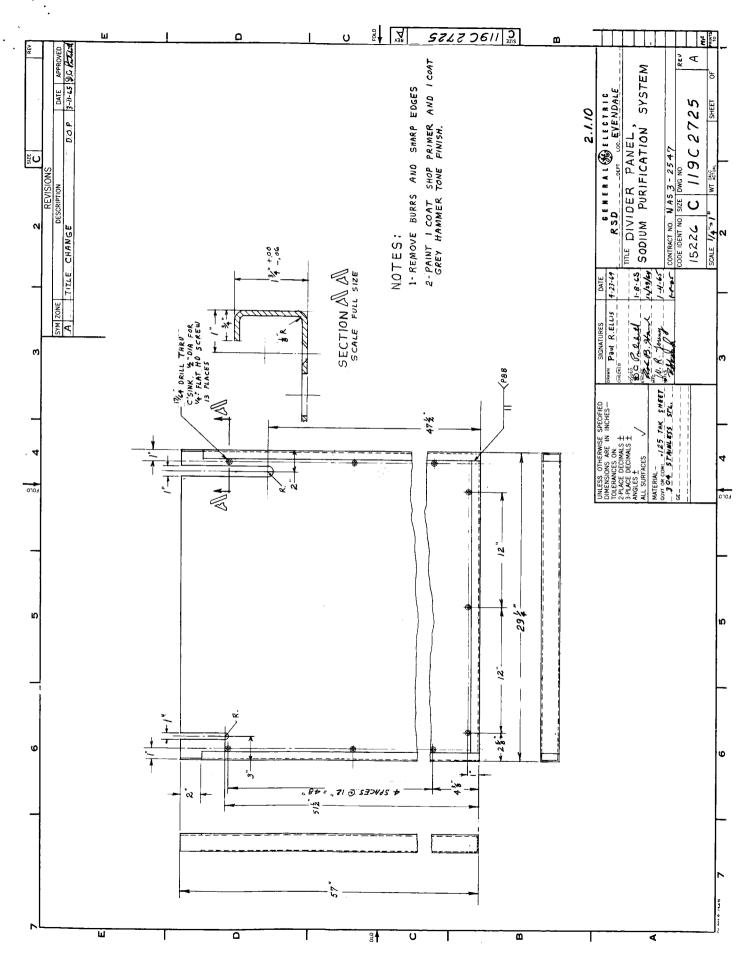


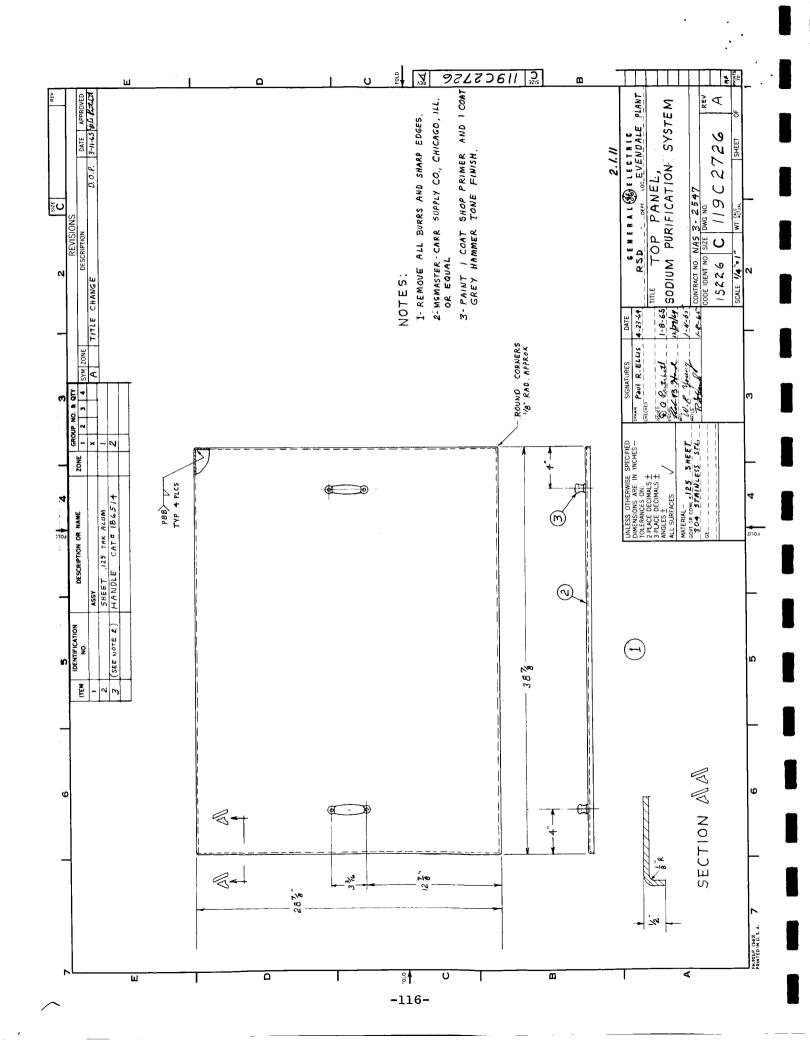


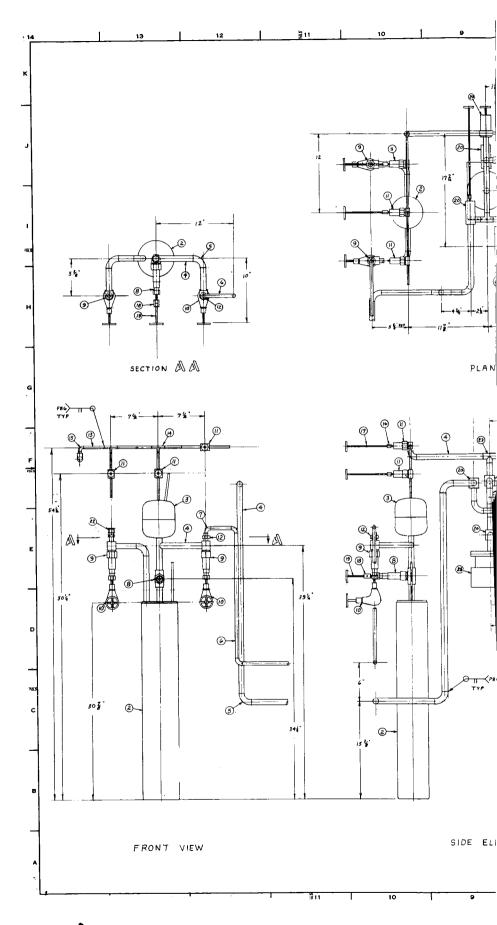




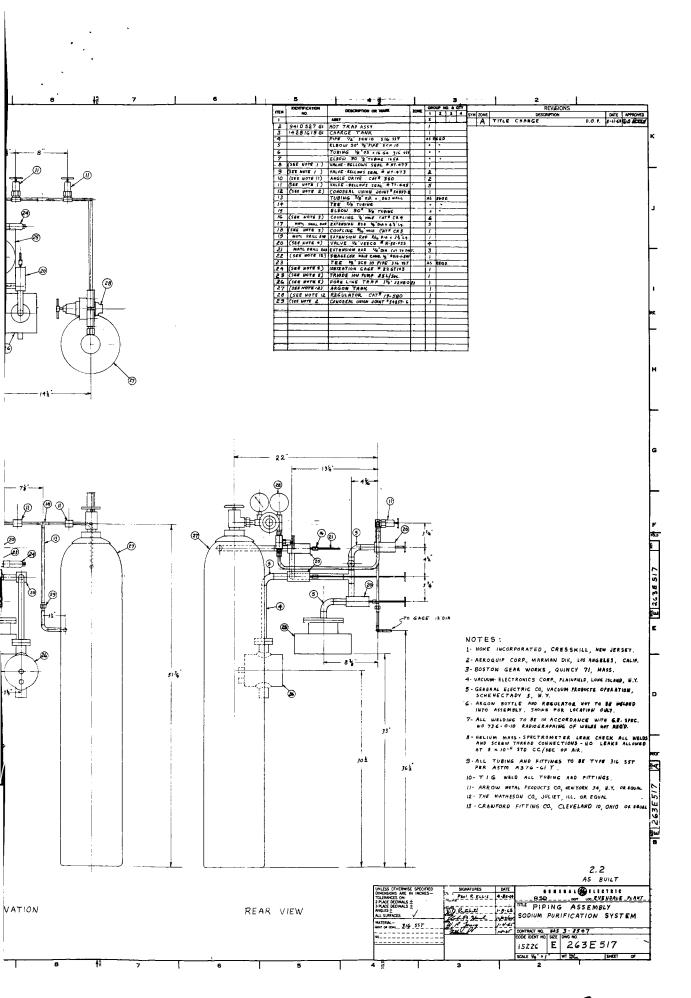


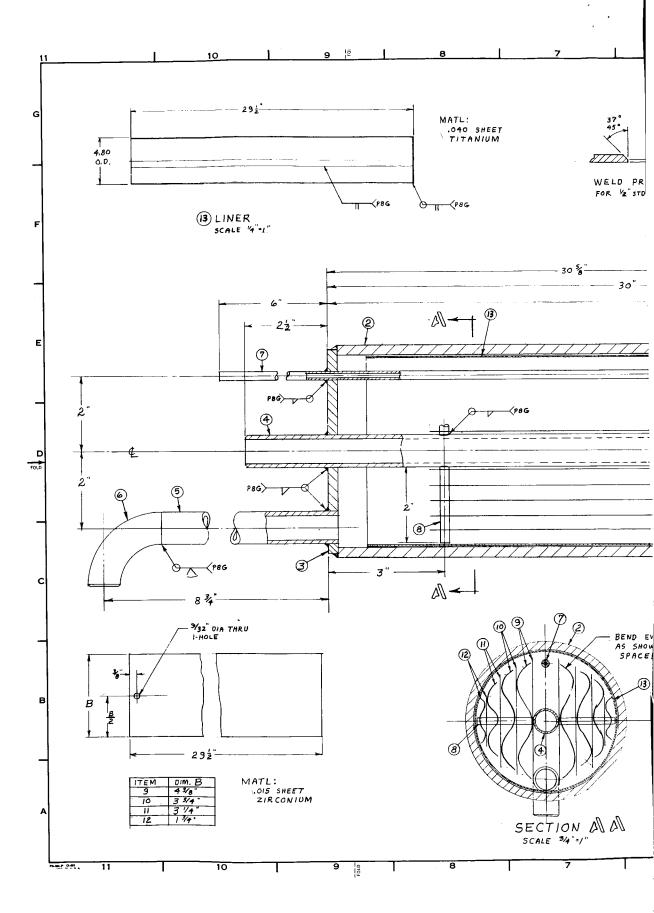


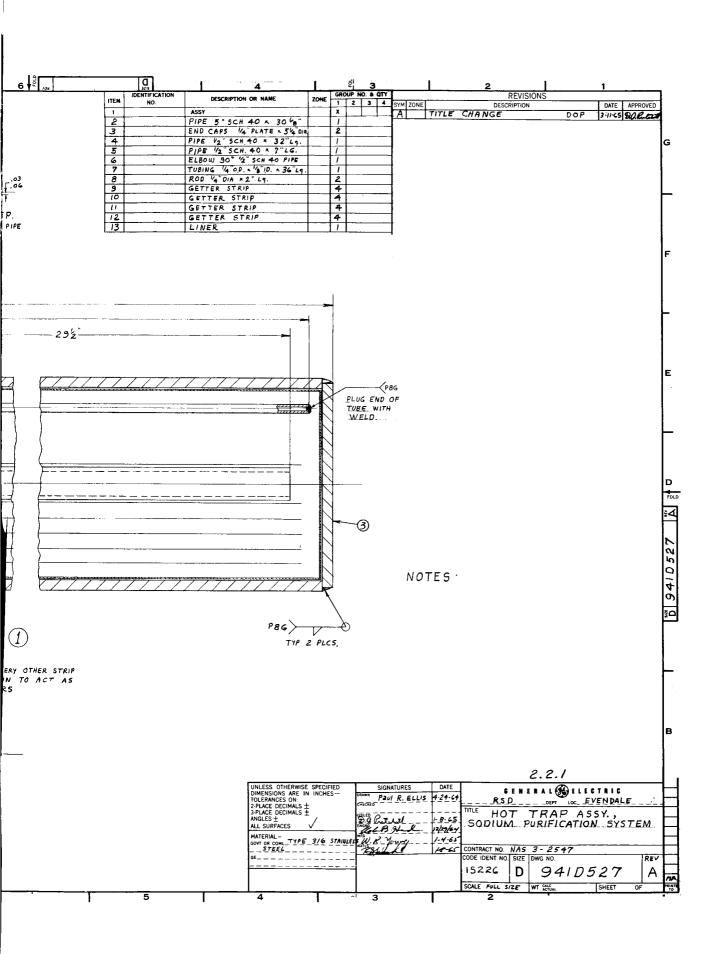


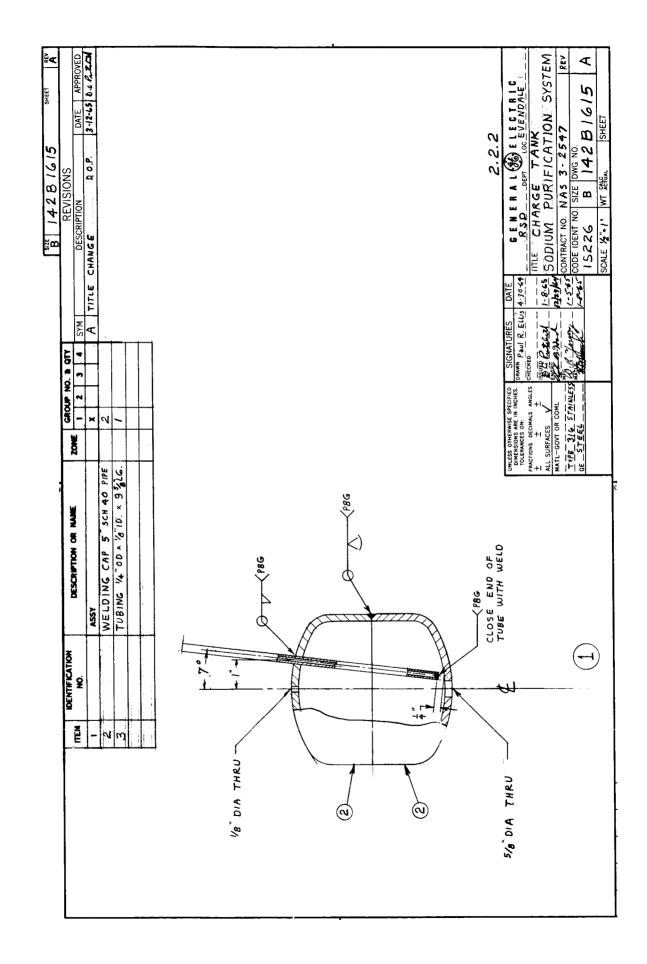


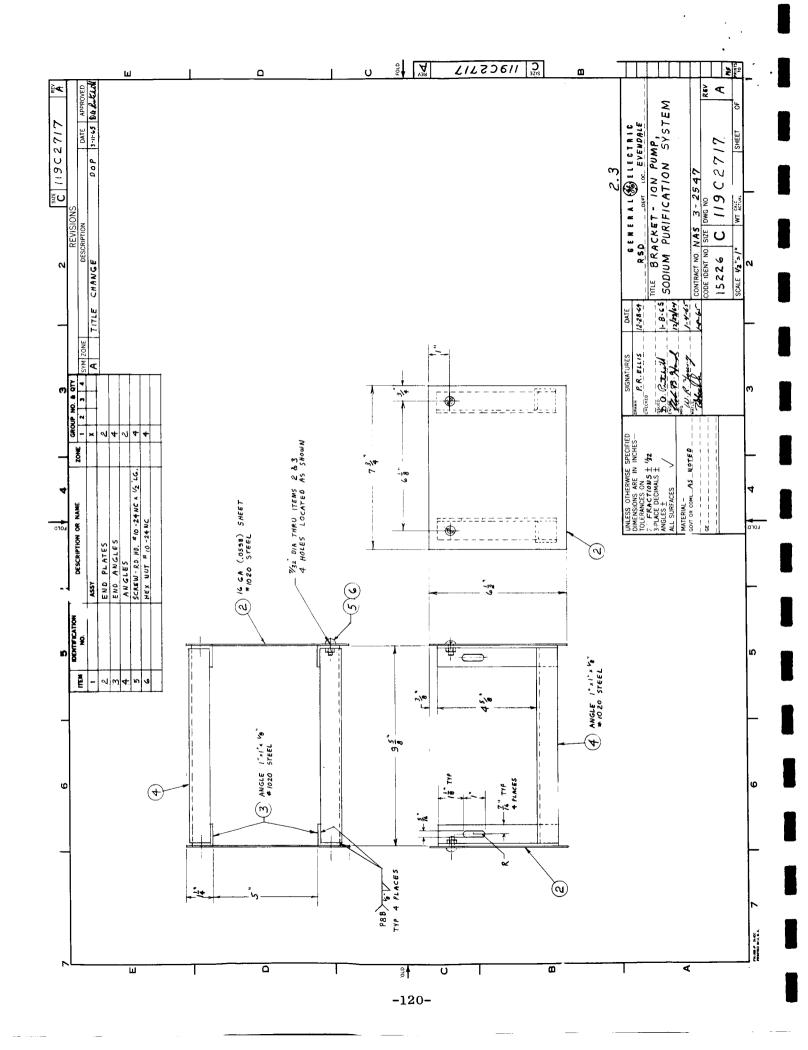
117-1

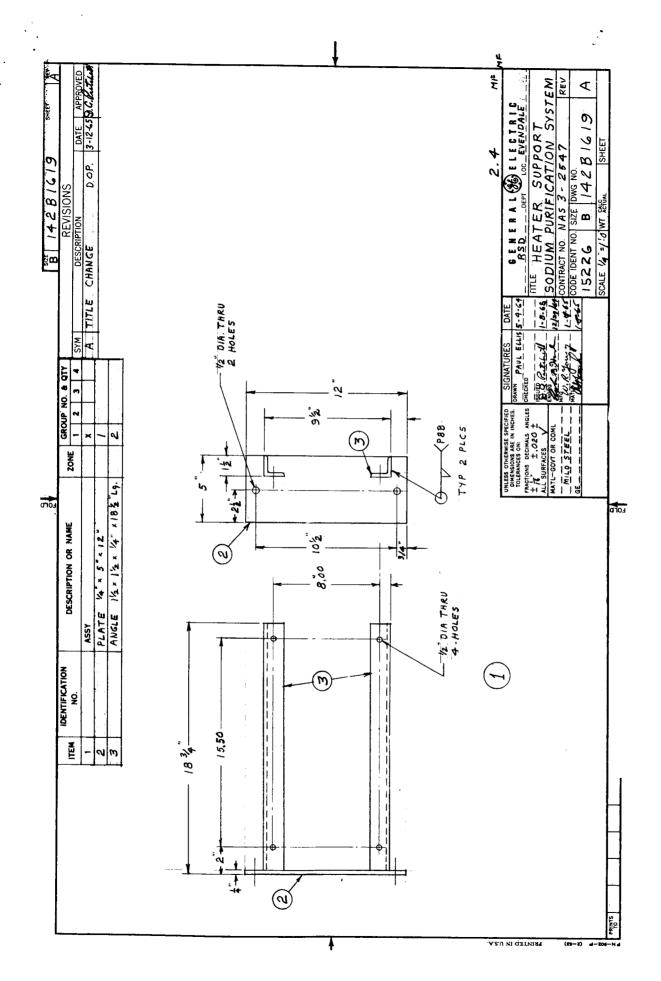








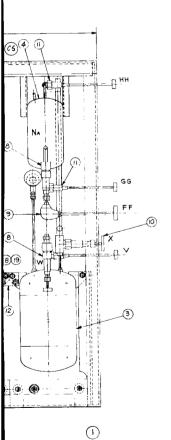




¢ DUMP TANK - 11,25 REF. -110 12.50 3.75 6 TO SURGE TANK 27 22(23) A-A waiv 7.50 DUMP TANK -- 20.62---:28.25 REF <u>(II)</u> @@ 54.0 REF. 50.25 FROM PURIFICATION (3) 40.5 32.0 28.0 (21)

| _             | (DENTIFICATION |  | ZONE | GROUP HO. & GTY |     |     |        |    |               |      | REVISIONS                             |  |  |  |  |
|---------------|----------------|--|------|-----------------|-----|-----|--------|----|---------------|------|---------------------------------------|--|--|--|--|
| ITEM          | NO.            | DESCRIPTION OR NAME                              | ZONE | $\Box$          | 2   | 3   |        | н  | 204           | 2774 | BANKSHIPTON BATE APPRO                |  |  |  |  |
| 1             | 263£ 731       | ASSY   |      | ×               | 1   | L_  |        | ш  | - 1           | Α.   | TITLE CHANGE D.O.P. 1-11-15 DAG       |  |  |  |  |
| 2             | 246 R 930GI    | CABINET_   |      | $\Pi$           | Γ.  |     | 1      | П  |               |      | CONOSEAL FITTINGS REMOVED MIS-45 FA.E |  |  |  |  |
| 3             | 263 E 734G1    | TANK, DUMP GODIUM)                               |      | 7               | 1   |     |        |    | 1             |      | FROM VALUE S PLACEDON                 |  |  |  |  |
| 4             | 941D755 G 2    | TANK, CHARGE                                     |      | 2               | 1   |     |        |    |               | В    | VALVE U , ITEM 10 WAS & REQD.         |  |  |  |  |
| -5            | 341075561      | TANK CHARGE (SOOWA)                              | -    | +-              | +   | L   |        | )  |               |      | ITEMS 26 & 27 ADDED.                  |  |  |  |  |
| 6             | # 54857-10     | CONOSEAL UNION FITTING                           |      | 1               | Г   | 1   |        | L  |               | L.,. | PER CN 0193                           |  |  |  |  |
| 7             | COML. OV-25    | HEATER 2500 WATT 120V.                           | T    | 2               | I.  |     | L      | ]  |               | C    | PART S DELETED                        |  |  |  |  |
| 8             | HY 473A        | ANGLE VALVE                                      | L    | l e             | Ι   | Ľ.  |        | i  |               | •    |                                       |  |  |  |  |
| ·* <u>ə</u> - | COML.          | RIGHT ANGLE DRIVE 350                            |      | 2               | Т   |     | 1      |    |               | l    |                                       |  |  |  |  |
| 10            | HY 477         | VALVE  | 1-   | 12              |     | Γ.  |        | ]  |               | ì    | 4 PART + GTY WAS I                    |  |  |  |  |
| 11            | TY 445         | VALVE  |      | Te              | 1   | Έ-  | 1      | 1  |               | 1    | 5 PART & DESC WAS TANK CHARGE P       |  |  |  |  |
|               | 165A5724PI     |  | _    | Ti.             | 1   | 1   | 1      | 1  | 1             |      | & PART 26 DESC WAS ANGLE VALVE        |  |  |  |  |
| 13            | COML           | TEE 1/2 x 1/2 1 PS                               |      | 4               |     | 1   | Г      | 1  | l             | 1    | PER CN 0212                           |  |  |  |  |
| 14            | COML           | 1/2 SCHED TO PIPE 304 SSTL                       | 1    | AS              | RE  | ₫Ď. | 1      | 1  | $\overline{}$ | -    | ***                                   |  |  |  |  |
| 15            |                | 12 OD.x.035 WALL 30+SSTL                         | † -  | AS              | RE  | ΦD. | Τ      | 1  |               |      |                                       |  |  |  |  |
| 16            | COML           | TUBING CROSS 304 SSTL                            | T    | 2               | 1   | 1   | 1      | 1  |               |      |                                       |  |  |  |  |
| 17            | COML           | TUBING TEE 304 SSTL                              | -    | 12              | 1   | 1   | Τ.     | 7  |               |      |                                       |  |  |  |  |
| iė            | COML           | 12-13 NC-2 BOLT 12 LONG                          | 1 -  | T6              | T   | T   |        | 1  |               |      |                                       |  |  |  |  |
| 19            |                | 5-BNC-2 HEX.NUT                                  | 1    | 16              |     |     | Τ-     | 1  |               |      |                                       |  |  |  |  |
|               | 14Z B 1784GI   |  | _    | 16              | 1   | t-  | Τ.     | ì. |               |      |                                       |  |  |  |  |
| 21            | 263F 734G2     | TANK, DUMP (POTASSIUM)                           | _    | T               | 1   | 1   | 1      | 1  |               |      |                                       |  |  |  |  |
|               | COML           | CAPSCREW %-16 x %LG. ST.                         | 1    | 18              | Ť   |     | $\Box$ | 1  |               |      |                                       |  |  |  |  |
| 23            |                | WASHER, FLAT TO ST                               | † -  | 18              |     | 1   | 1      | 1  |               |      |                                       |  |  |  |  |
| 24            |                | BOLT HEX HO %-IGNC &LG                           | 1    | 14              |     | 1   | $\top$ | 1  |               |      |                                       |  |  |  |  |
| 23            |                | NUT 30-16 NC                                     | 1    | 14              |     | +   |        | 1  |               |      |                                       |  |  |  |  |
|               | HY 473         | VALVE  | 1 -  | 14              | 1   | +-  | 1      | ٦  |               |      |                                       |  |  |  |  |
|               | 54857-8        | CONOSEAL UNION FITTING                           |      | 4               |     | 1 . | 1      | 1  |               |      |                                       |  |  |  |  |
| 21            | 31037.0        | COMPACING CONTRACTOR                             | +    | +-              | +   | T   | 1      | 1  |               |      |                                       |  |  |  |  |
| <b></b>       | <del></del>    | <del> </del>                                     | +    | +-              | +   | +   | Ť      | 1  |               |      |                                       |  |  |  |  |
|               |                |  | +    | +               | +-  | +   | 1      | 1  |               |      |                                       |  |  |  |  |
| -             | <del> </del>   | +  | 1-   | +               | +   | +   | +      | 1  |               |      |                                       |  |  |  |  |
| ⊢             |                |  | +    | +               | +   | +   | +      | 1  |               |      |                                       |  |  |  |  |
| <b>}</b> ←    | +              | <del>                                     </del> | +-   | +-              | 1   | +-  | +      | 1  |               |      |                                       |  |  |  |  |
| -             | +              | +  | +    | +               | -+- | +   | +-     | 1  |               |      |                                       |  |  |  |  |
| <b>-</b>      |                |  | +    | +               | +   | Ť   | +-     | 1  |               |      |                                       |  |  |  |  |
|               |                |  |      |                 |     |     |        |    |               |      |                                       |  |  |  |  |

A - EDWIN L. WEIGAND CO. PITTSBURG & PA. (CHROMOLOX HEATER)
B - HOKE INC. CRESSKILL, N.J.
C - ARCO METAL PRODUCTS, NEW YORK 34, N.Y.
D - AEROQUIP CORP., MARMAN DIV., LOS ANGELES, CALIF.



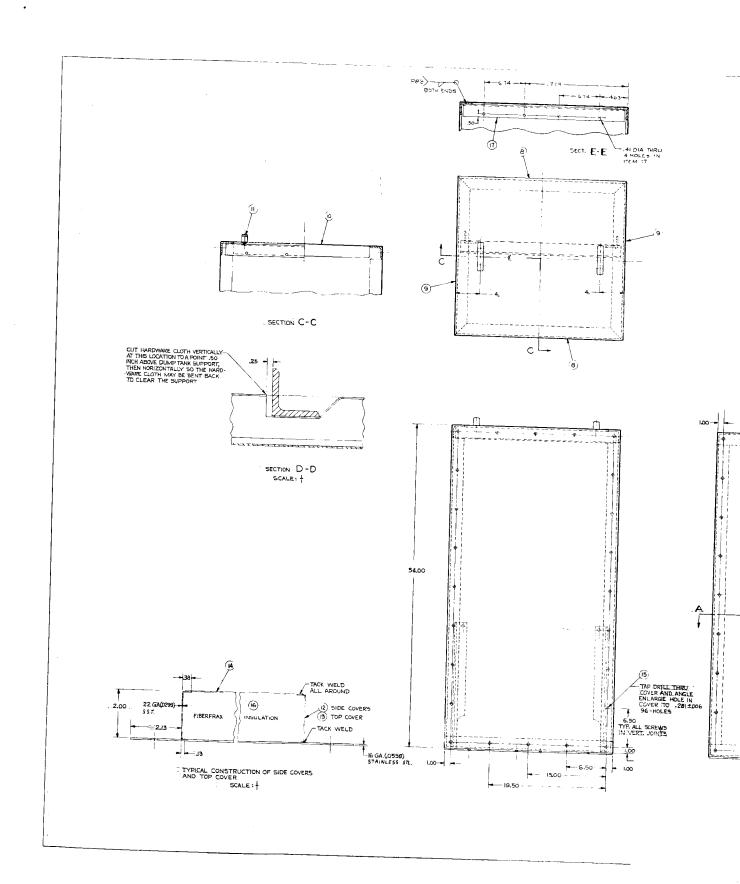
## NOTES:

- 1-ALL WELDING TO BE IN ACCORDANCE WITH GE SPEC. SPS-41. RADIOGRAPHING OF WELDS NOT REGD.

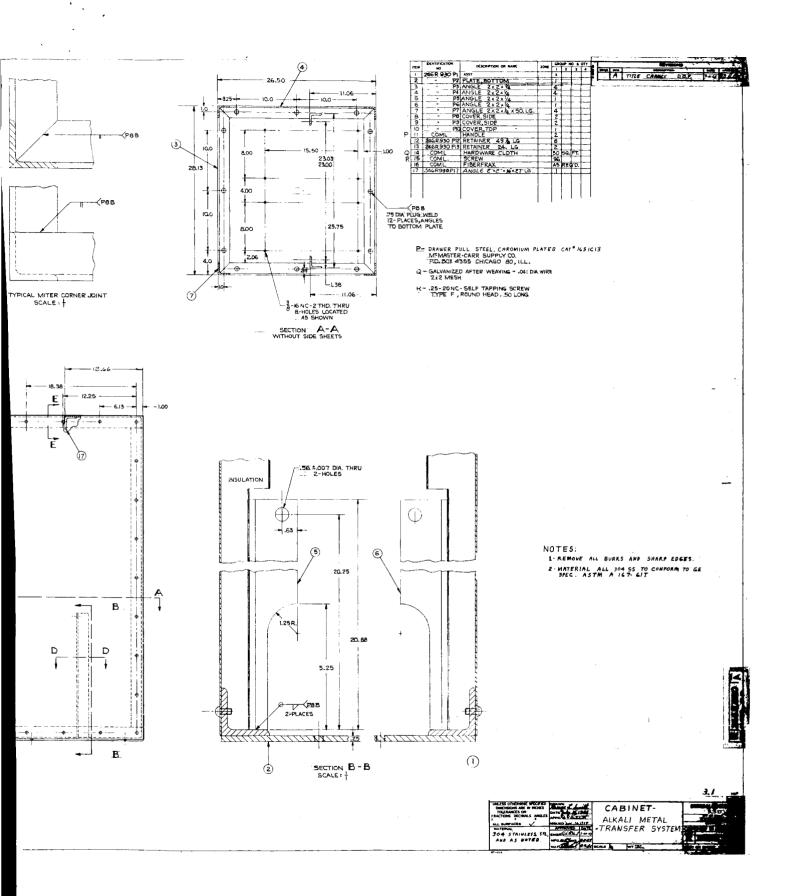
  LEAK TEST PER SPS-26, NO LEAKS ALLOWED EXCEDING 5 \* 10 14 STD, C.C. OF AIR FER SEC.
- 3-MATERIAL:
  ALL THE 304 SST SEAMLESS PIPE PER ASTM A 312-617
  ALL THE 304 SST SEAMLESS THE PER ASTM A 249-61
  ALL TIPE 304 SST PLATE PER ASTM A 147-617

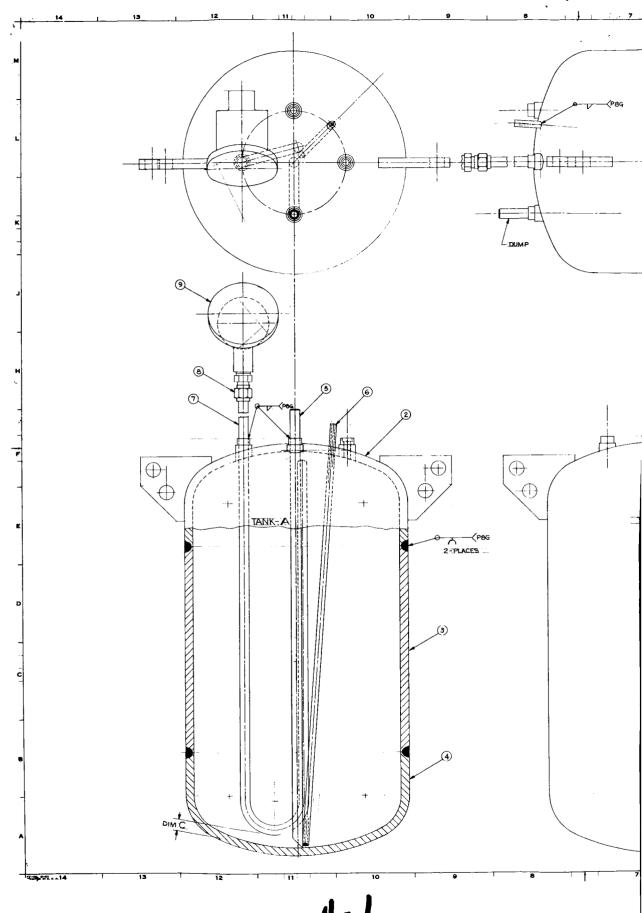
263E73[ |C

| •  |           | 3.0                       | )<br>Process      |
|--|-----------|---------------------------|-------------------|
| UNLESS OTHERWISE SPECIFIED DISAWN DISCRESSIONS AND IN HICHES TOLERANCES ON: FRACTIONS DECIMALS ANGLES ANGLES ALL BUNYACES (ISBURY) |           | ALI METAL<br>NSFER SYSTEM | SEMERAL SELECTRIC |
| AS NOTED ENGINE  | COMP DATE | for 200m                  | E 263E 731        |

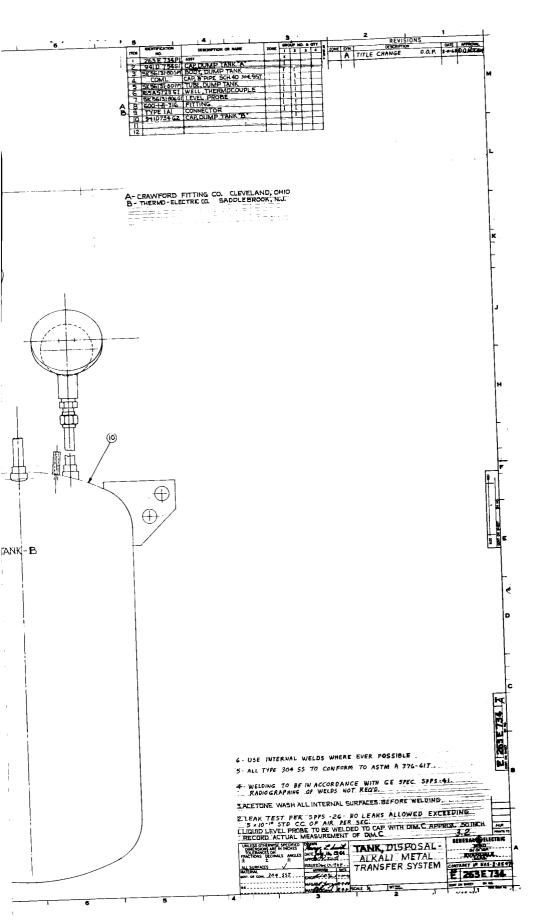


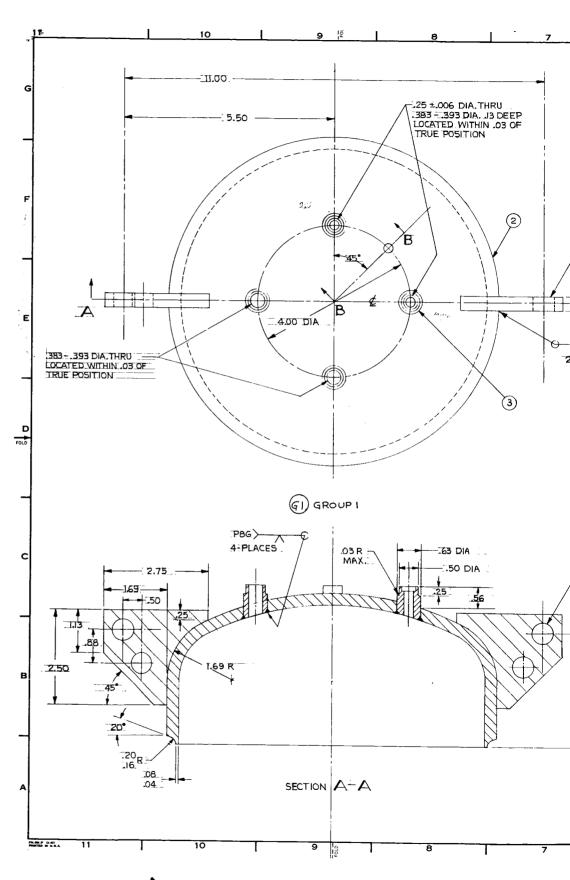
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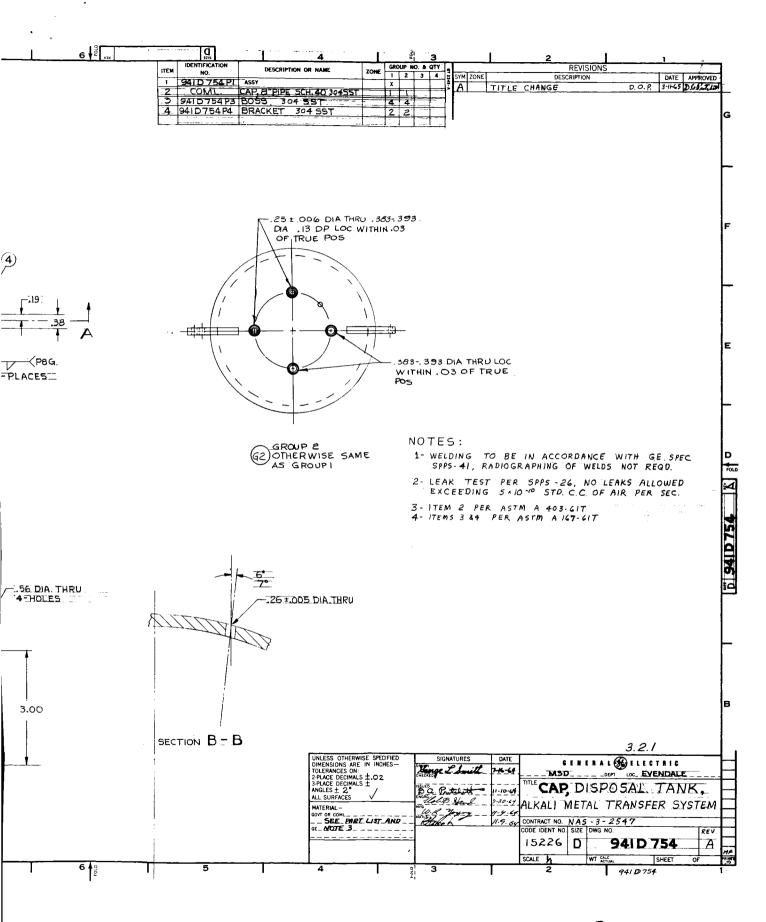


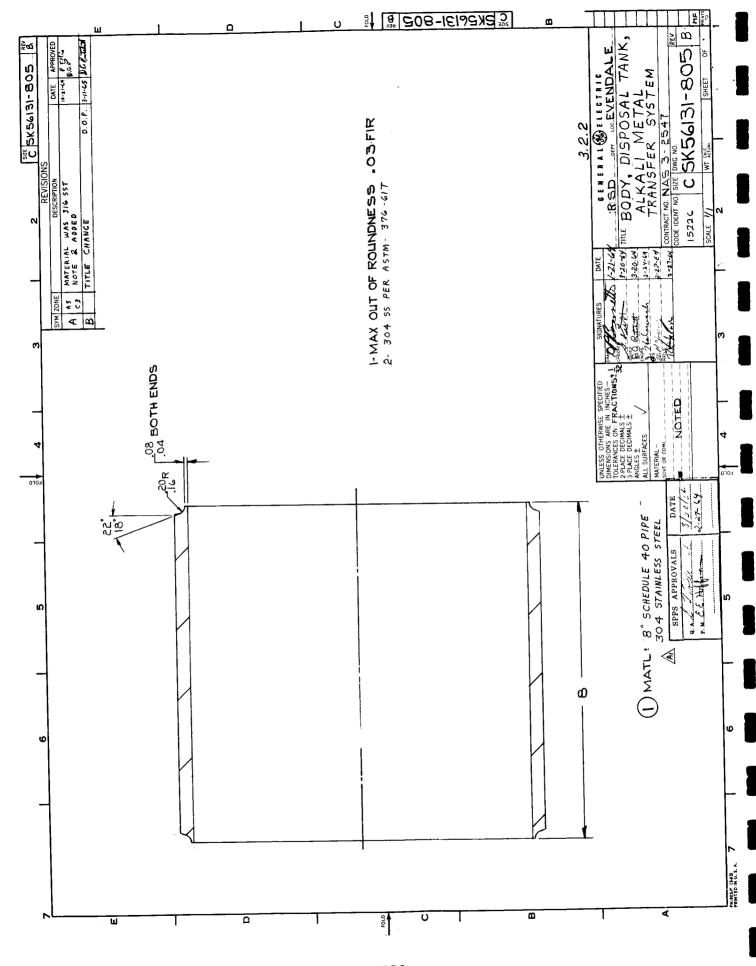
124-1

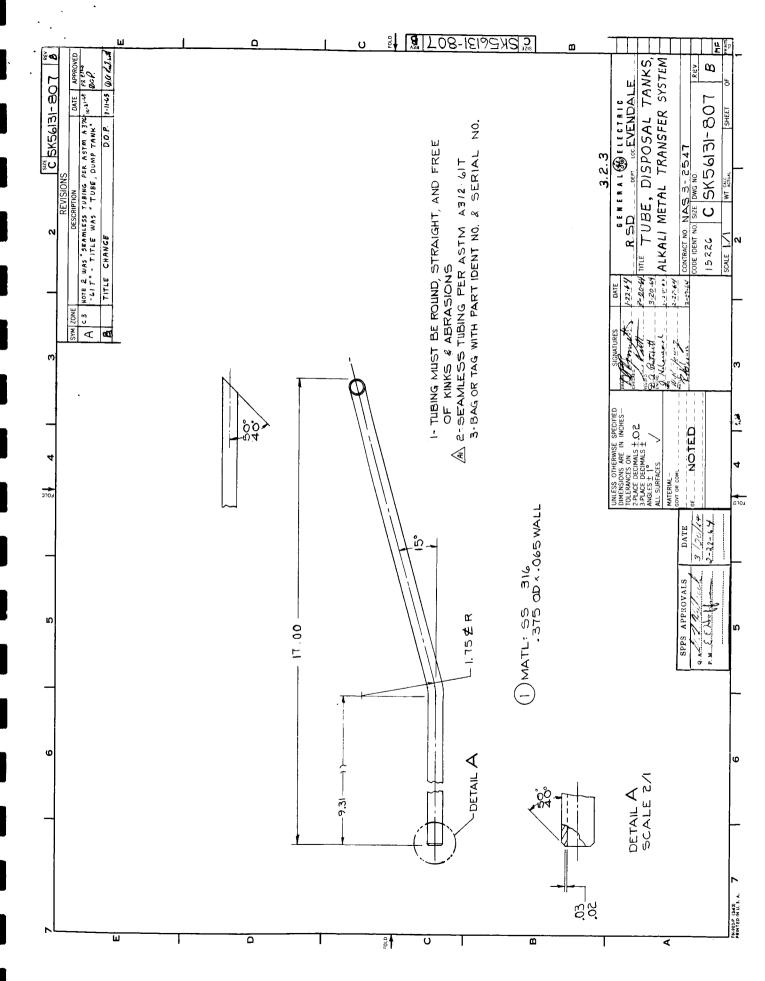


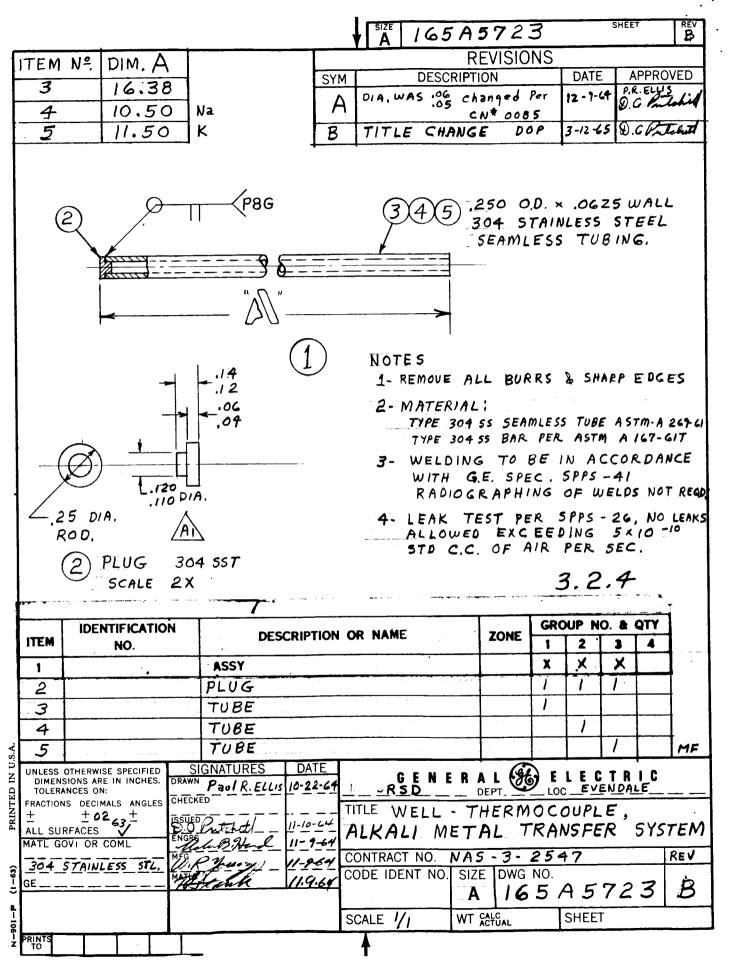


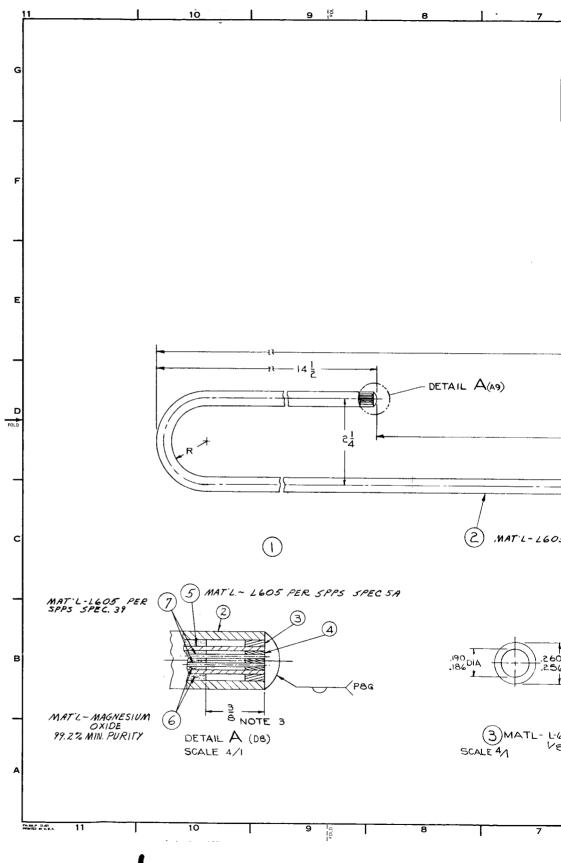
1 25



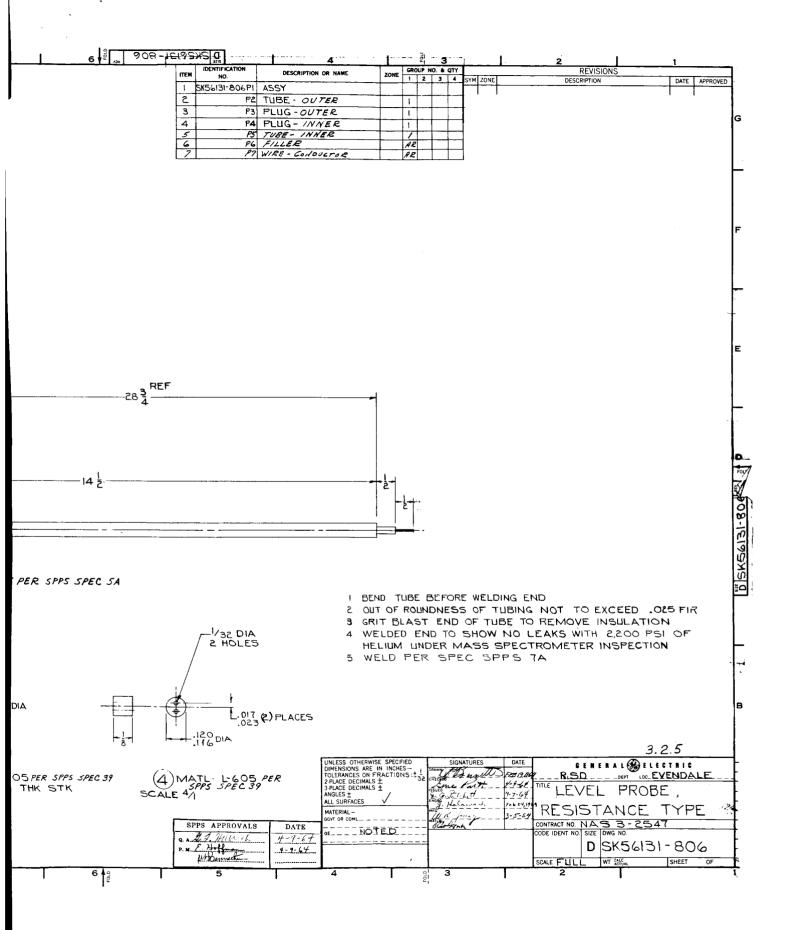


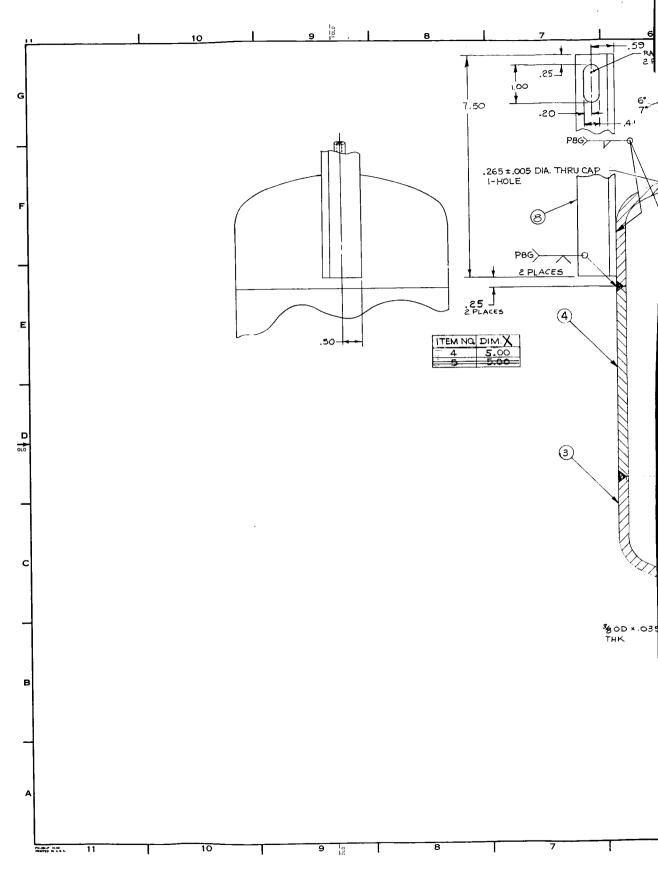




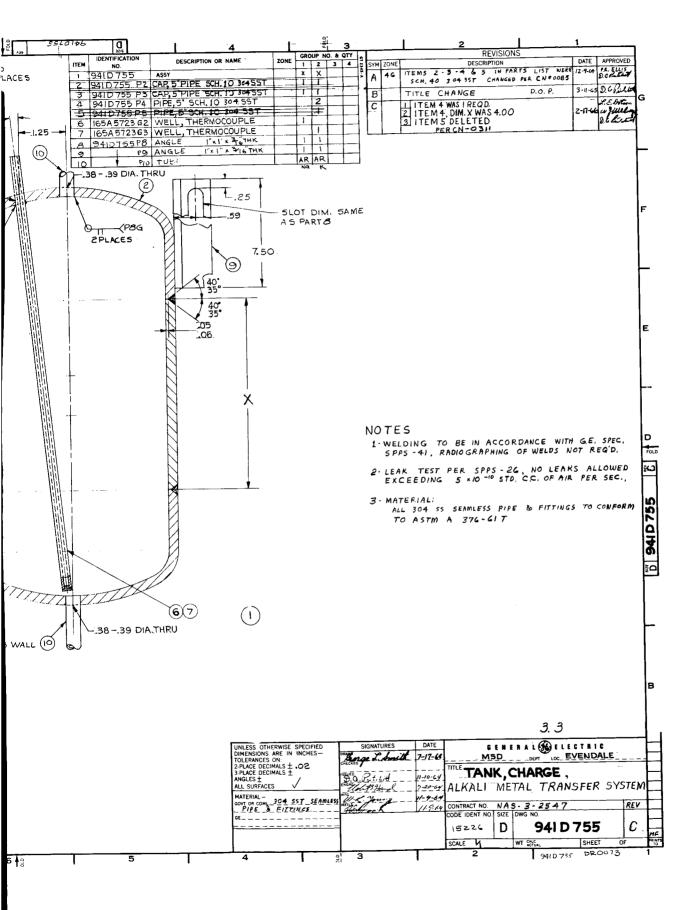


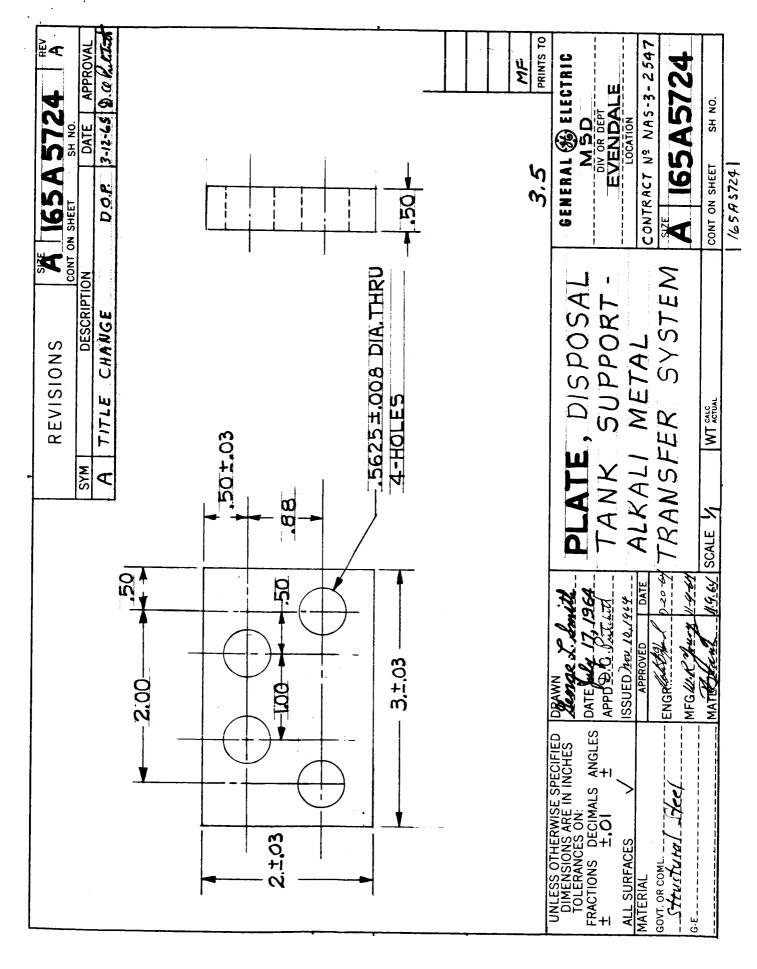
129.

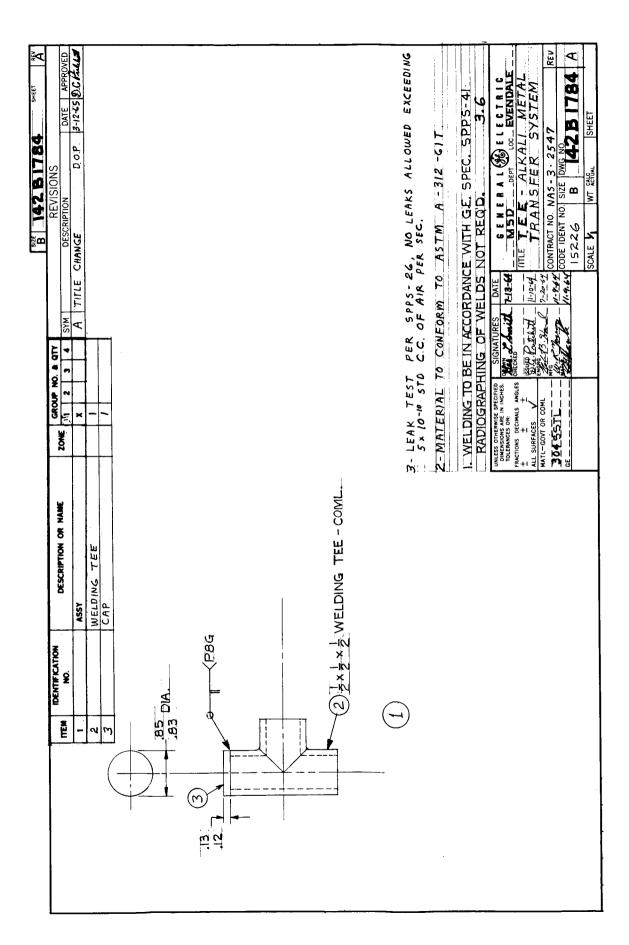


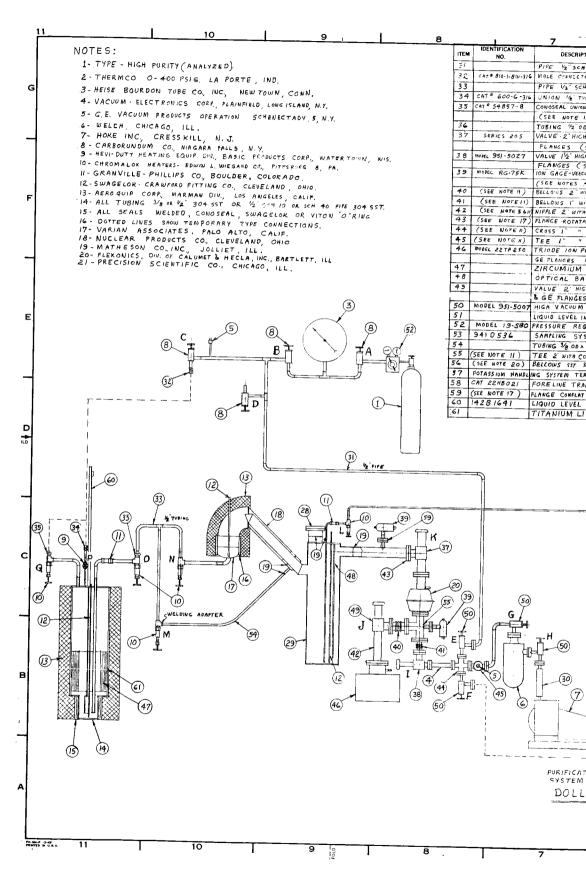


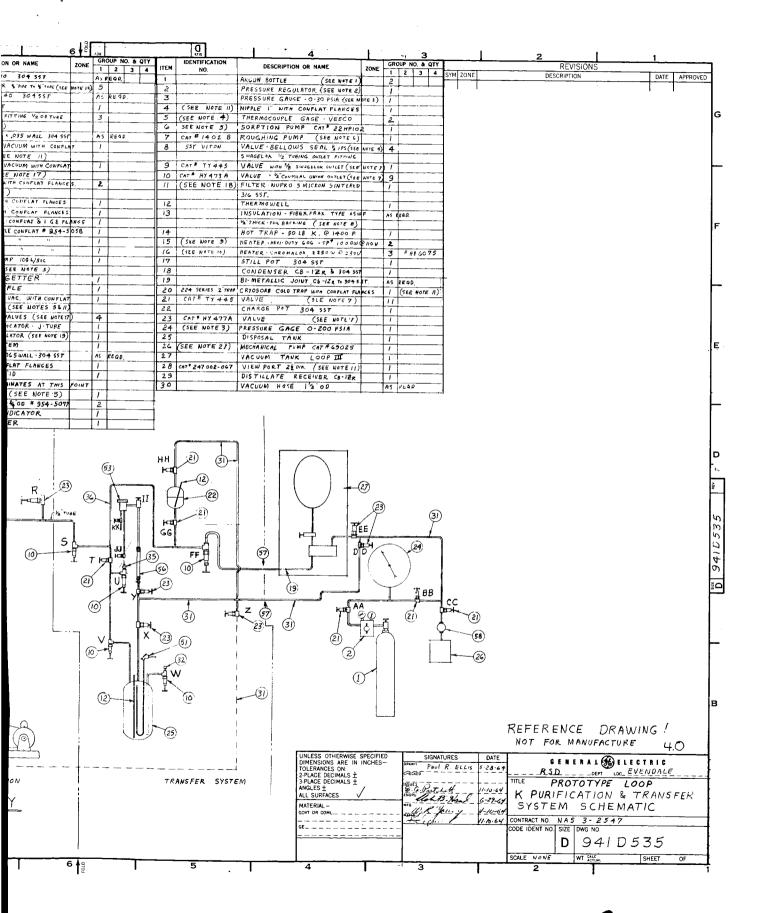
130-1

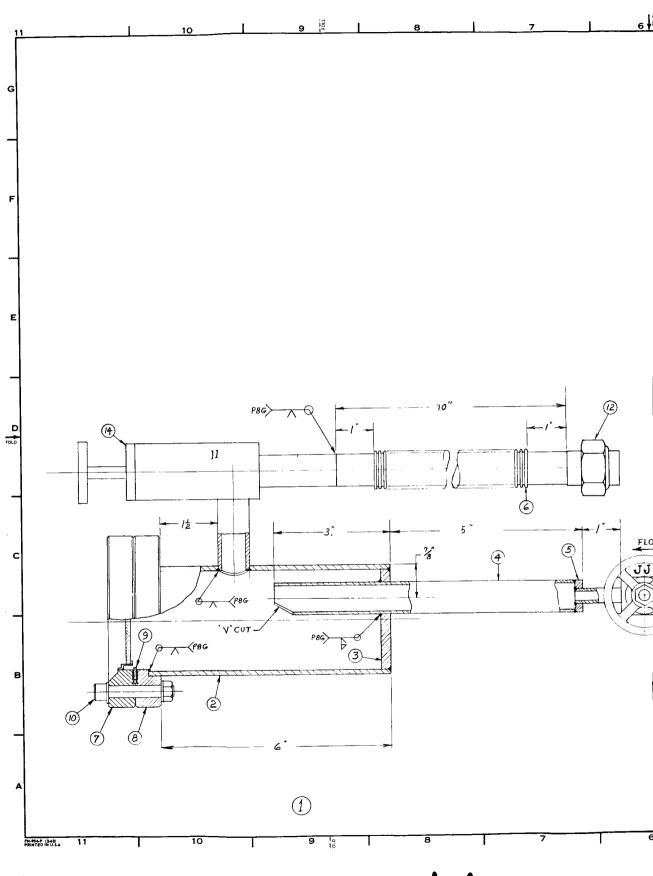




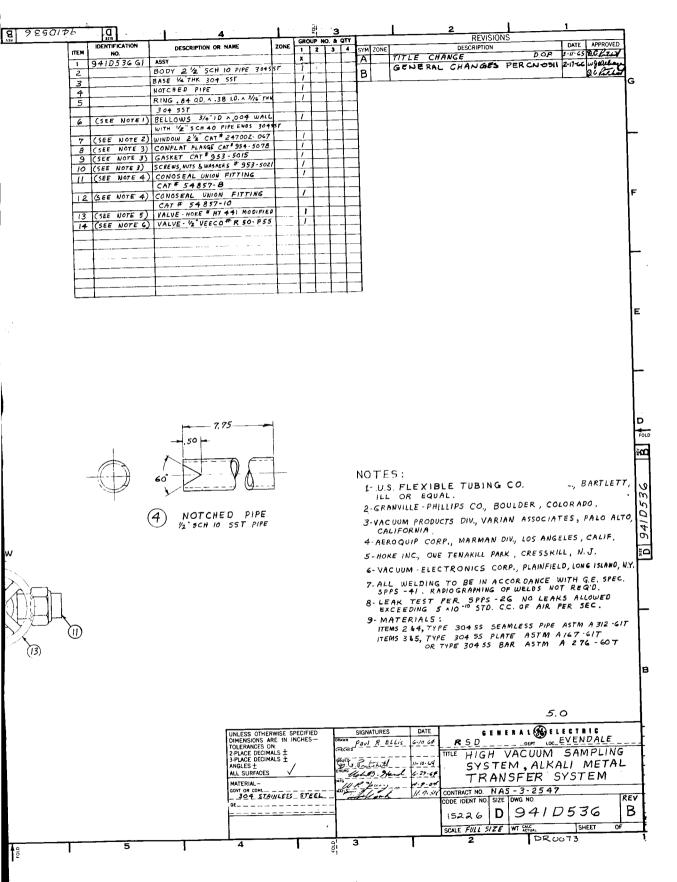


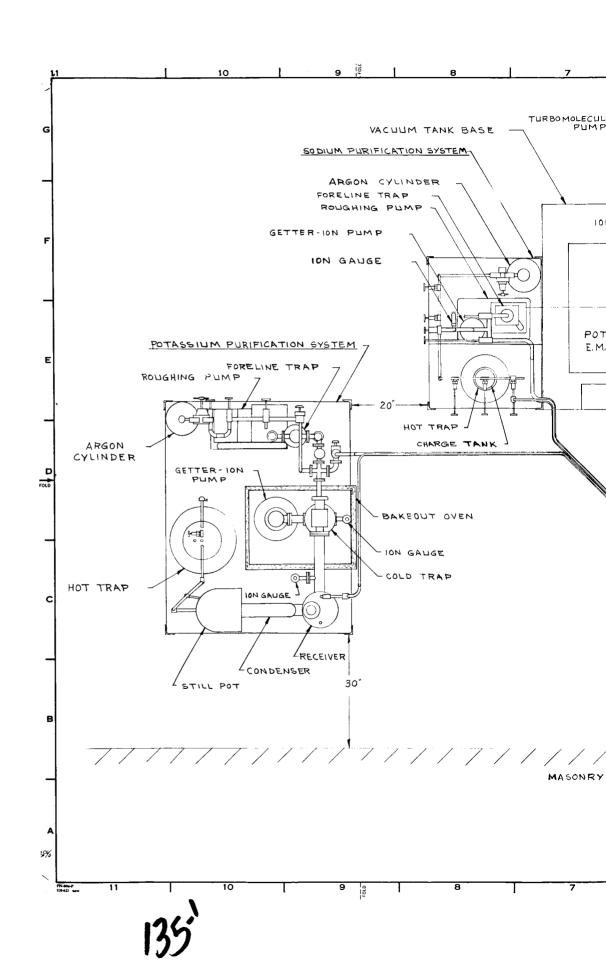


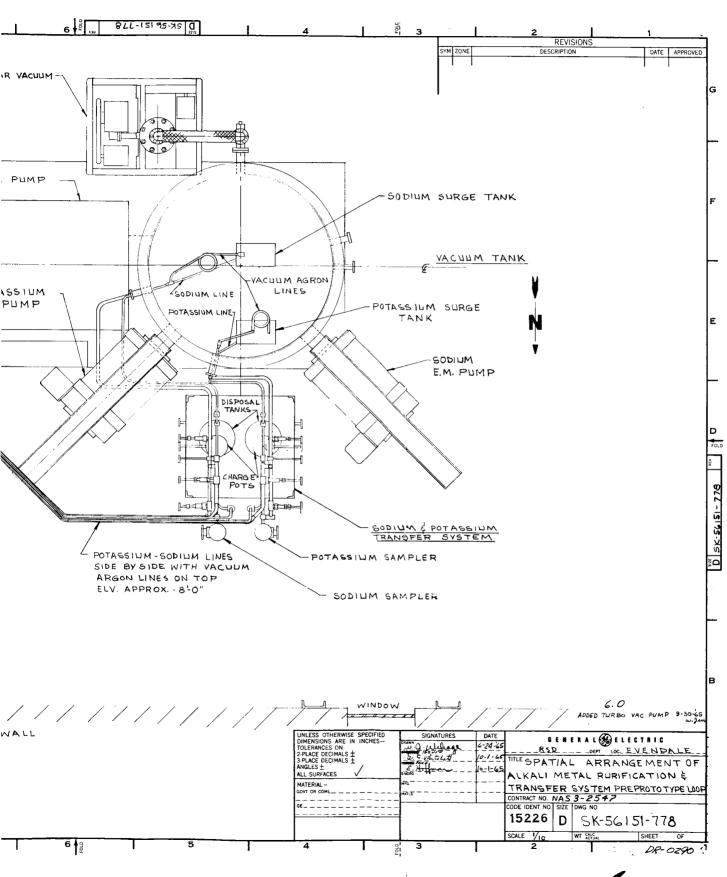


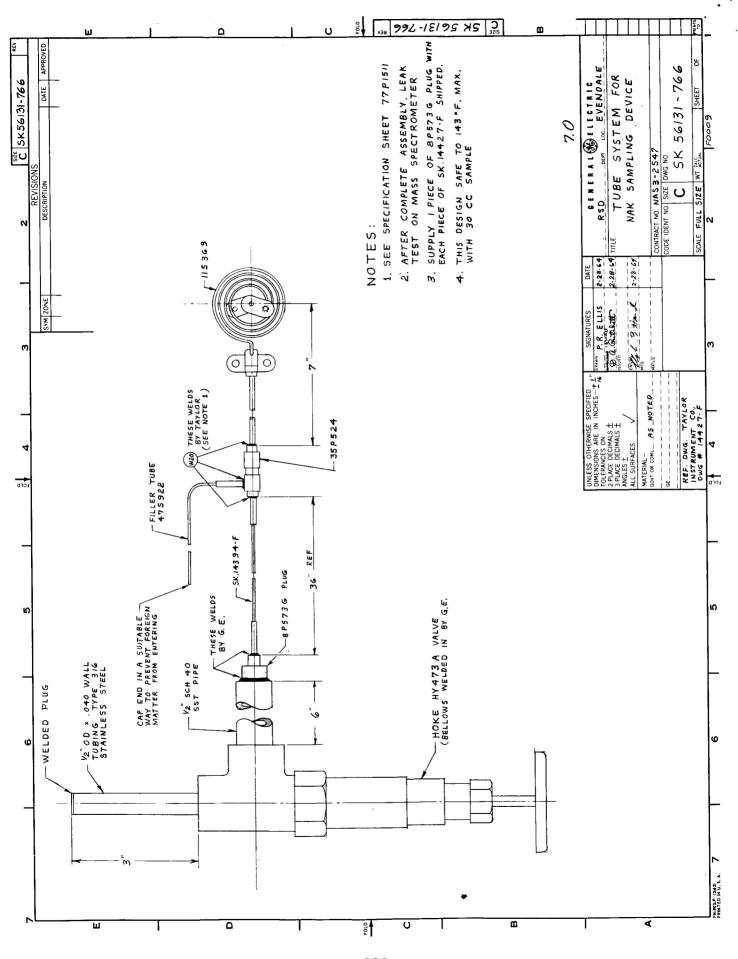


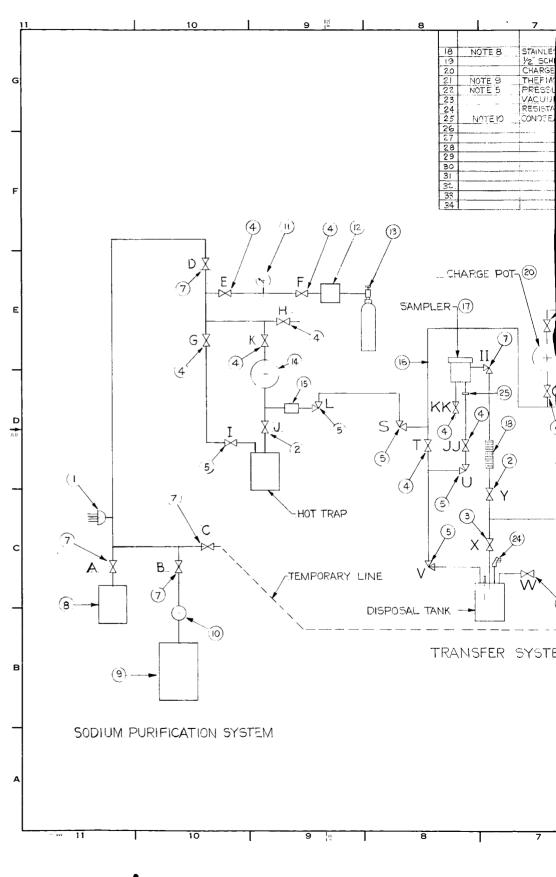
134-1

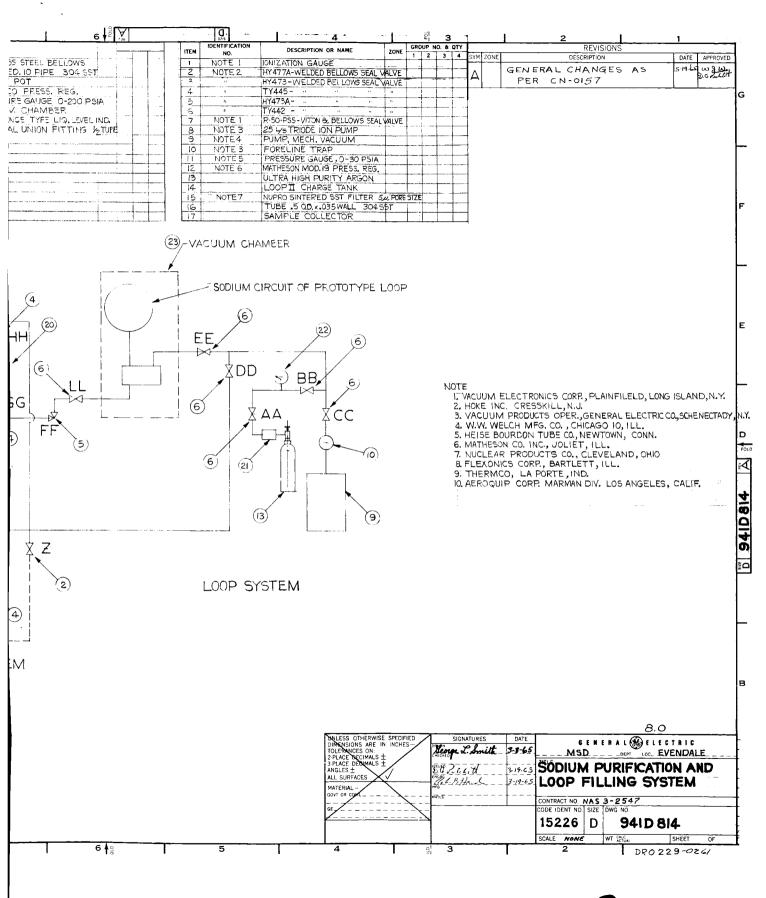


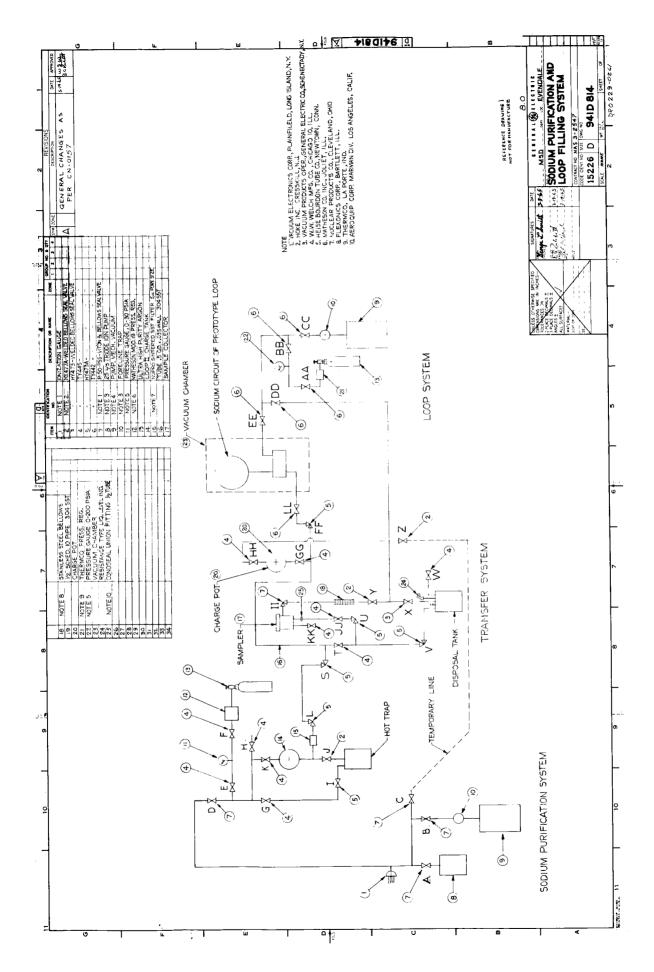






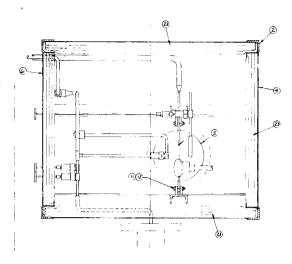






VACUUM TANK (3)<del>P</del> E.M. PUMP FRAME 10000 DLAN VACUUM TANK 2": 2" - " ANGLE FRAME CAPACITOR HOUSING

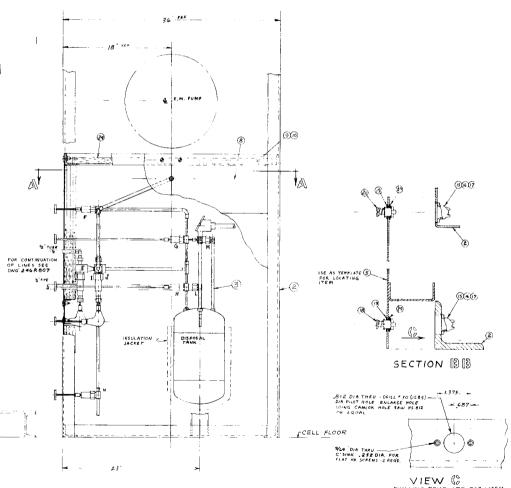
ELEVATION
PANELS REMOVED



| IITM     | IDENTIFICATION<br>NO | DESCRIPTION OR NAME              | ZOME     | GROUP NO. & GTY |          |   |   |  |
|----------|----------------------|----------------------------------|----------|-----------------|----------|---|---|--|
|          |                      | ASSY                             | 200      | 1               | 2        |   | ٠ |  |
| <u>_</u> | 243E 513             | SUPPORT FRAME                    | <b>—</b> | X               | <u> </u> |   | _ |  |
| 2        | 243 E 5 12           | PIPING ARRANGEMENT               |          | 1               | ١.       |   |   |  |
| 3        | 11902725             | REAR PANEL                       | 1. i     | ľ.              | L.       |   |   |  |
| 5        | 119 6 27 16          | FRONT PANEL - LOWER              | i !      | 1               |          |   |   |  |
|          | 1190 2728            | PRONT PRINEL-LOWER               |          | 1               | L_       |   |   |  |
| 6        |                      | FRONT PANEL - UPPER              | i        | 1.              |          |   |   |  |
| 7        | 14281619             | HEATER SUPPORT                   | 1        | 2               |          | _ |   |  |
| 8        | 142 8 1620           |                                  | L        | 1               |          |   |   |  |
| 9        |                      | SCREW . TRUSS HO 1/4-164C+1      | ks l     | 4               | Γ-       |   |   |  |
| 10       |                      | NUT - HEX HD 3/6 /6 NC           | Ι        | 4               | Ī        |   |   |  |
| 11       |                      | SCREW HEX HD. 12 - 13 NC . 14    | 149      | 2               |          |   |   |  |
| 12       |                      | NUT - HEX HD. 1/2 - 13 NC        | 1 - 1    | 2               | Γ        |   |   |  |
| /3       |                      | SCREW HEX HD 7/2-14 NC . I'LY    | 1        | ė               | 1        |   |   |  |
| 14       |                      | NUT HEX 7/6 - H NC               | I        | 8               | Γ.       |   |   |  |
| 15       | CAT # 214 22         | RECEPTACLE RIGIO TIPE I RI       | VET      | 18              | 1        |   |   |  |
|          | I                    | SPACING (SEE NOTE I)             | 1 1      | 1               |          |   |   |  |
| 16       |                      | SCREW FLAT HD . 5.40 . 1249.     | 1 1      | 34              | 1        |   |   |  |
| 77       |                      | NUT- 19. \$5-40                  | i i      | 36              | 1        |   | _ |  |
| 18       | CAT# 40579 - 11      | STUD ASSY SLOTTED NO SEE NOTE    | 70" [    | 12              | _        |   |   |  |
| 19.      | CAT # 4002 N         | GROMMET (SEE NOTE!)              | 1 1      | /8              | Ε.       |   |   |  |
| Z0       | CAT * R 4G - 040     | SNAP RING (SEE NOTE!)            | 1 - 1    | 18              | Ε.       |   |   |  |
| 21       | CAT 40579 - 4        | STUD ASSY - SLOTTED HO (SEE WITE | DJ 1     | 6               | -        |   |   |  |
| 22       | (SEE NOTE 2)         | HEATER TYPE OU CATE OU 25        | 1 1      | 2               | -        |   |   |  |
| 23       | (SEE NOTE 3)         | FIBER FRAX INSULATION TIPE X5W   |          | 140             | OFT      | A |   |  |
|          |                      | (WITH FOR BACKING) VA THICK      | 1 1      | _               | 1        |   |   |  |
| 24       | SEE NOTE 4)          | ASBESTOS THERM-BOARD             |          | 1               | t        |   |   |  |
|          |                      | 1 THICK . 25 . 35                |          | -               | +        |   |   |  |
|          |                      |                                  | _        | -               |          |   |   |  |
|          |                      |                                  |          | ⊢-              | t-       |   | _ |  |
|          |                      |                                  |          | <del> </del>    | ⊢-       |   | - |  |
|          |                      |                                  |          | ١.              |          |   | _ |  |
|          |                      | <del></del>                      |          | -               | -        |   |   |  |
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|          |                      | L                                | L        | _               |          |   |   |  |



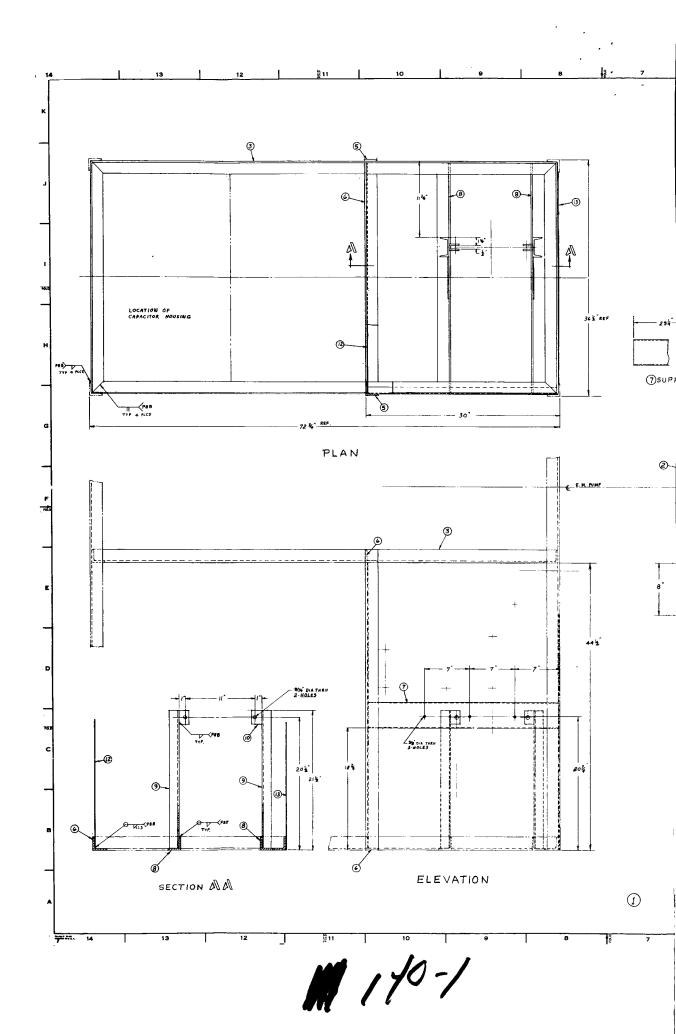
END VIEW

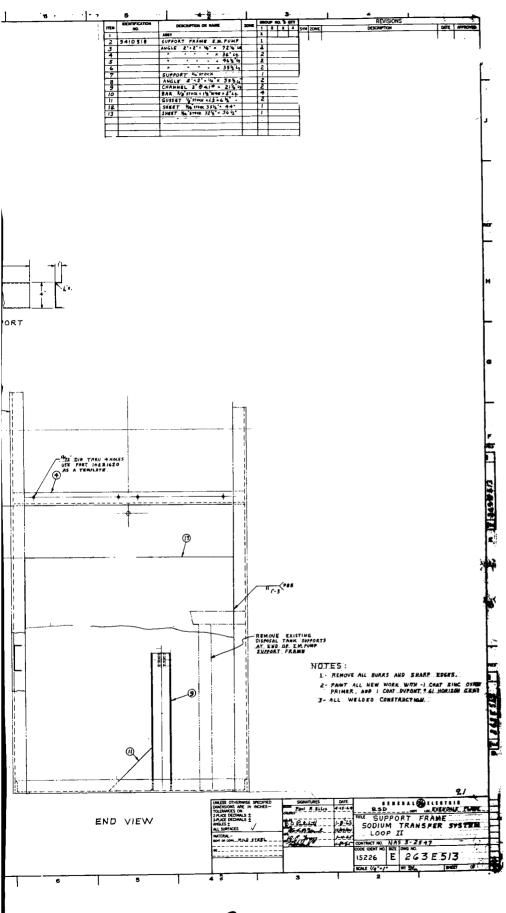


- 1 CAMLOC FASTENER CORP., PARAMUS, N.J. OREQUAL 2- CHROMALOX HEATERS - EDWIN L. WIEGAND CO., PITTS BURG B, PA., OR EQUAL 3-CARBORUN DUM CO., NIAGARA FALLS, N.Y. OR EQUAL
- 4- JOHNS MANVILLE, NEW YORK 16, N.Y. OR EQUAL.

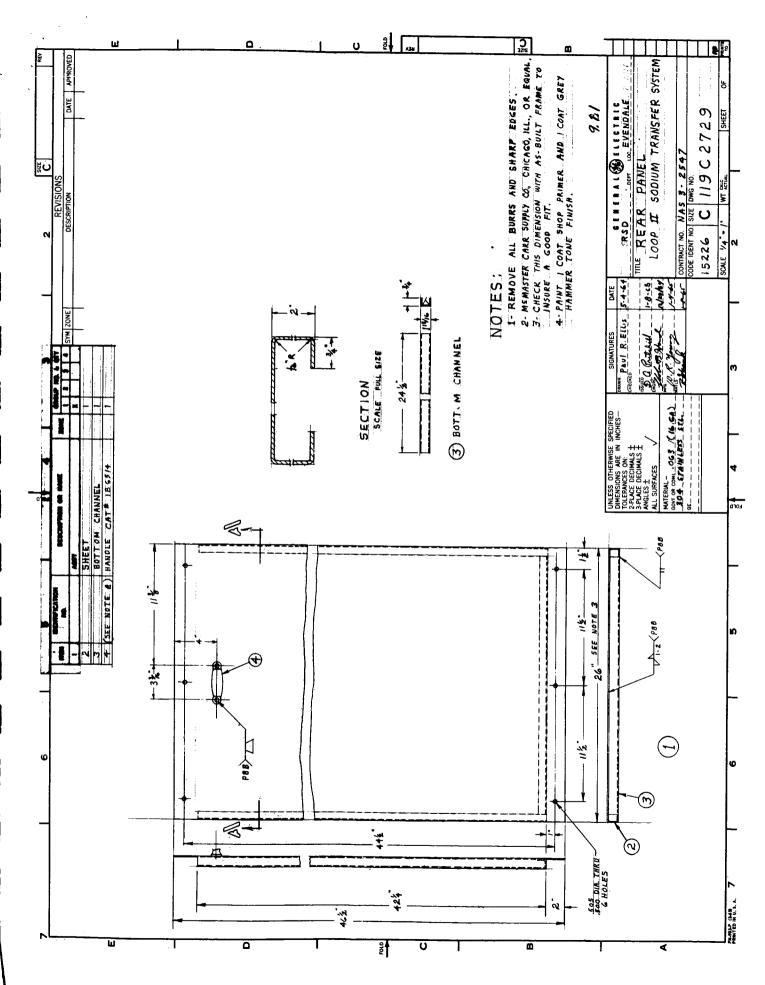
VIEW (0 DIVILLING TEMPLATE FOR TITEM USE PANELS AS TEMPLATE FOR LOCATING THE EXACT POSITION OF HOLES

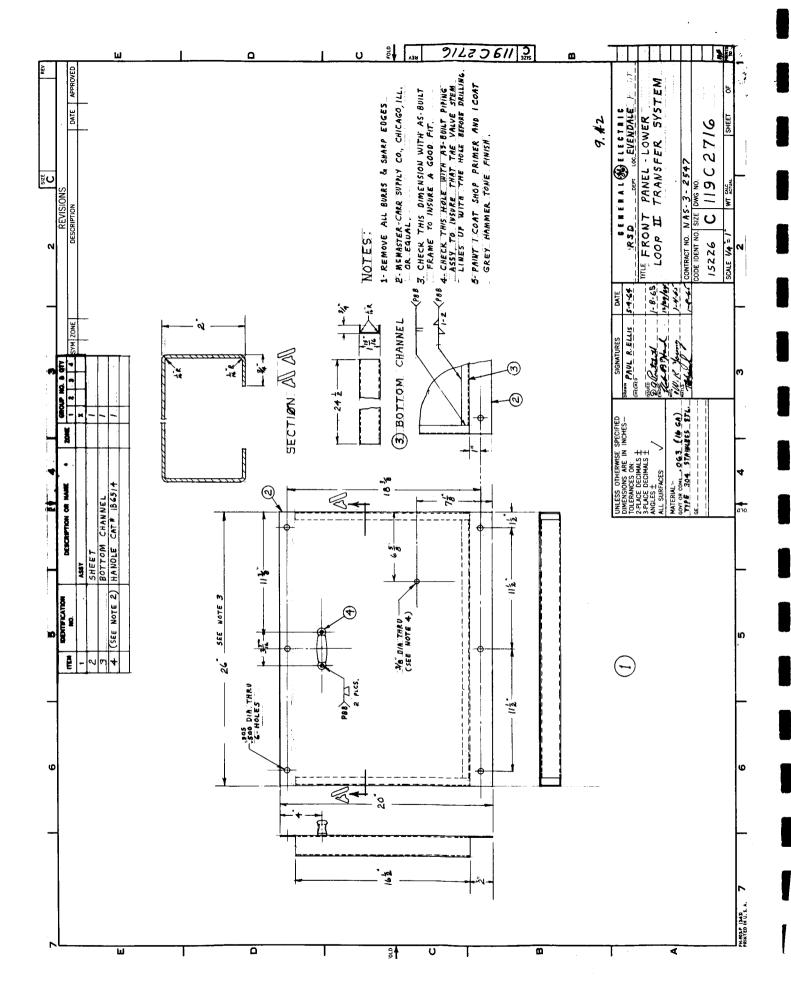
EVENDALE PLANT
CONTRACT \* WAS 3 - 2547 LOOP II SODIUM TRANSFER SYSTEM

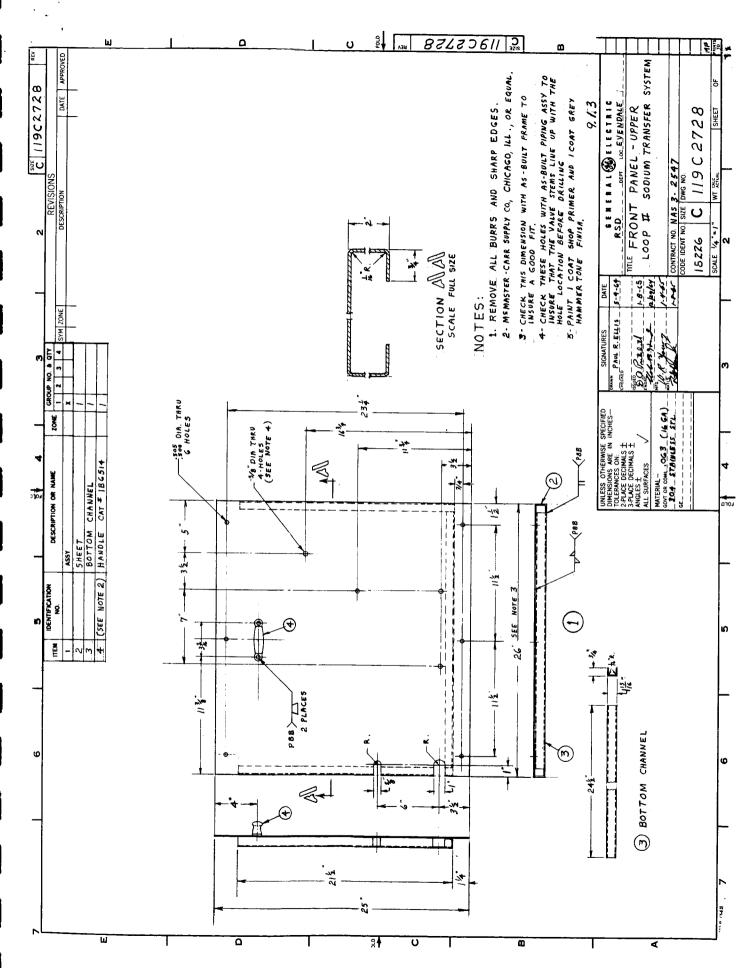


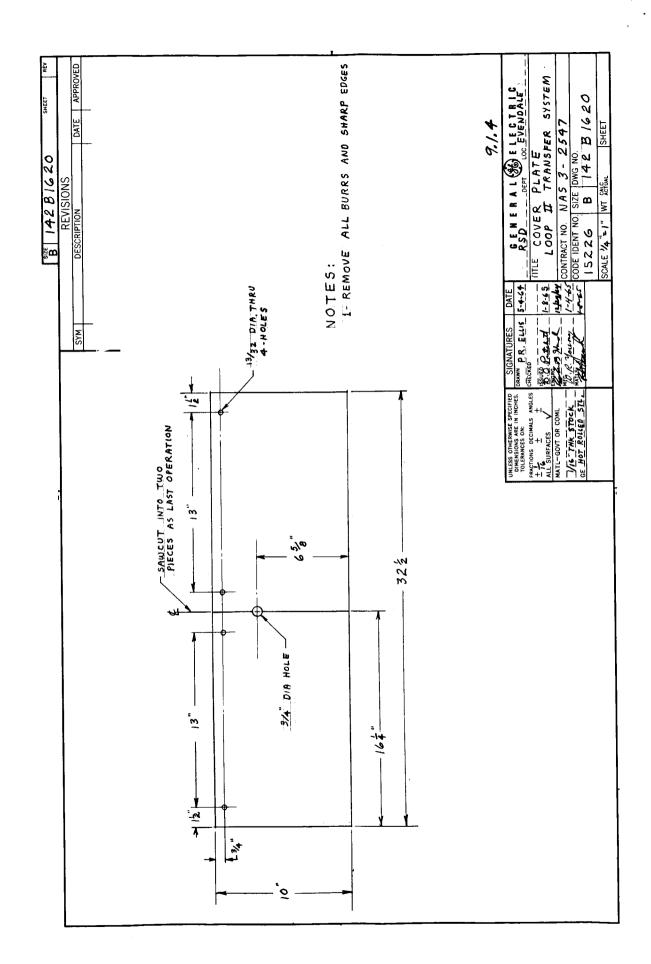


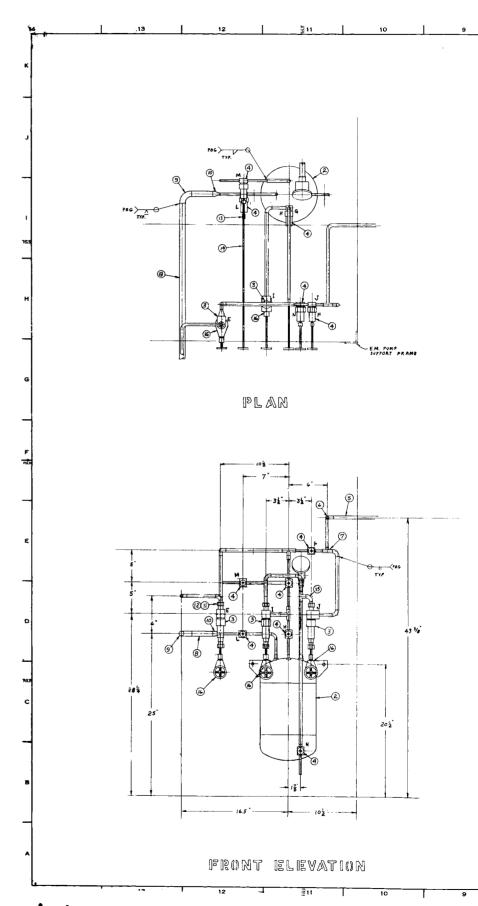
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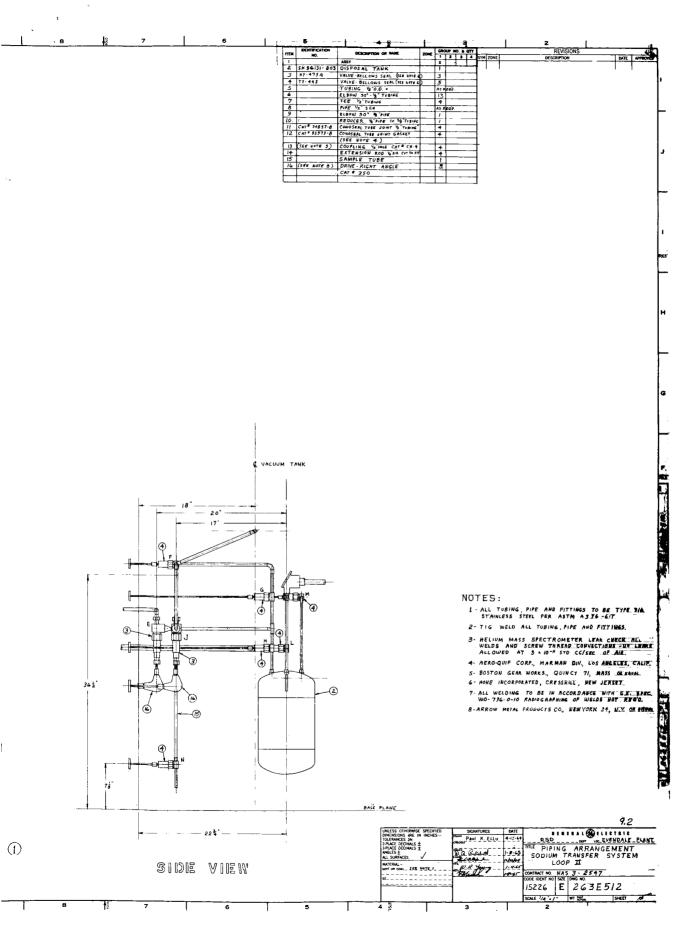


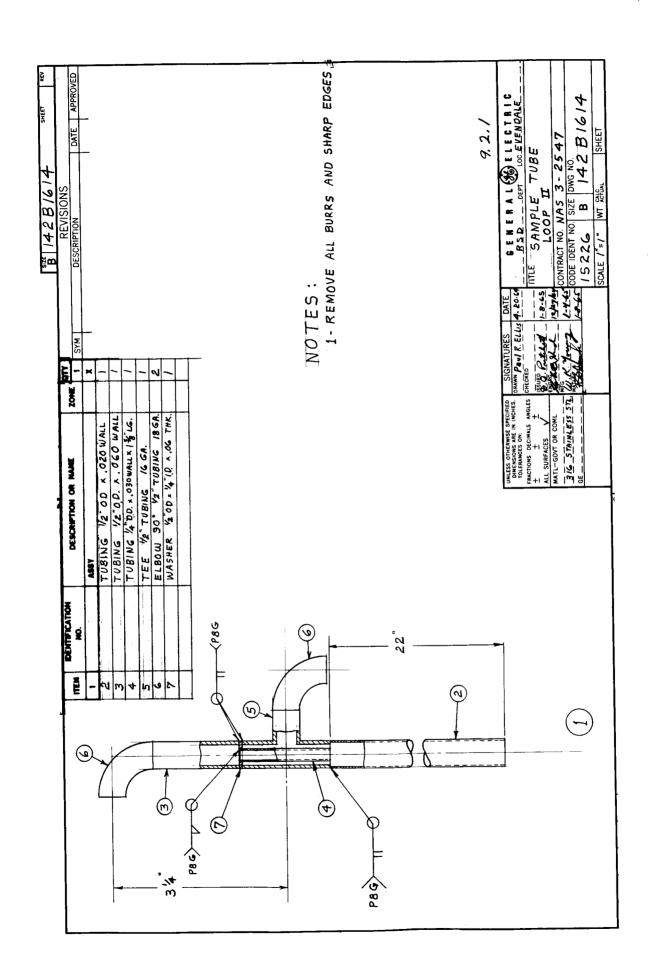


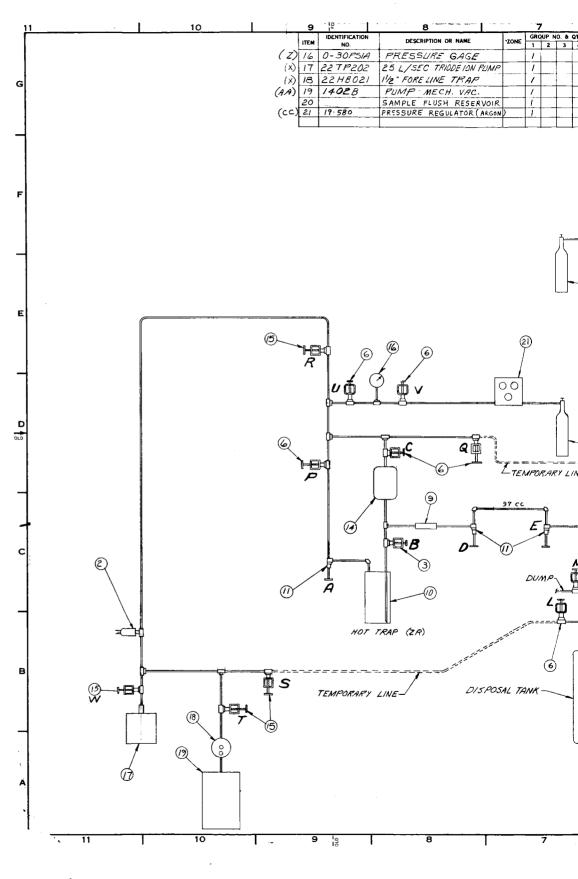




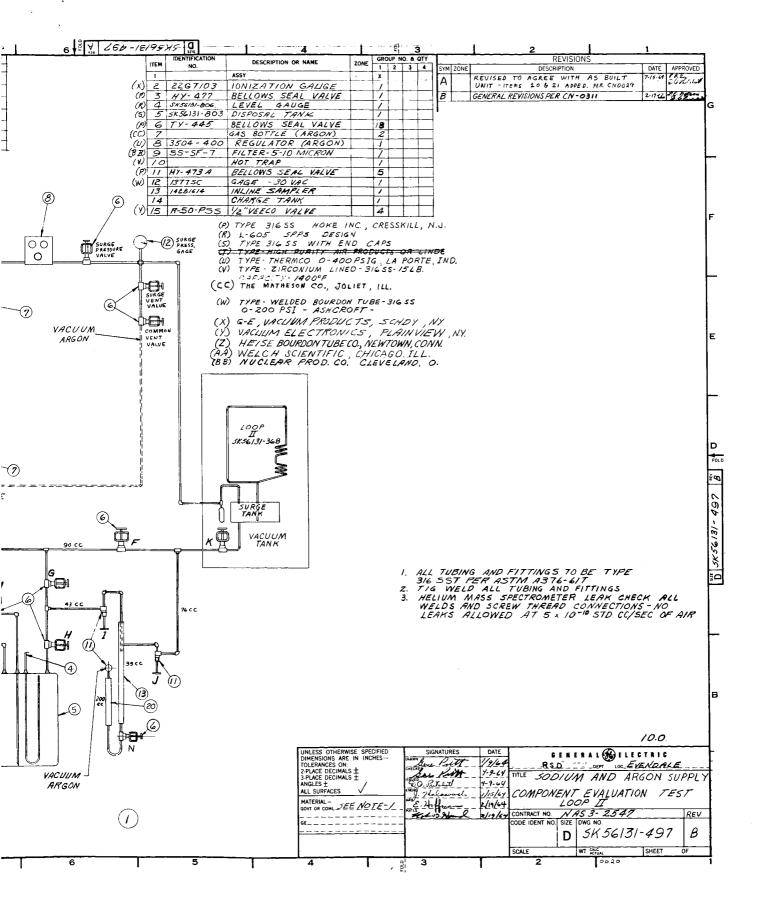
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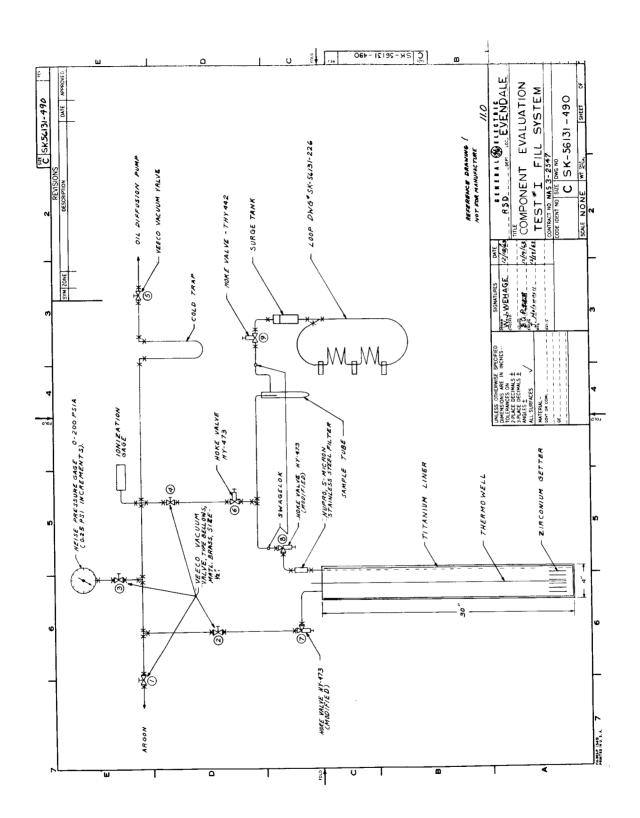


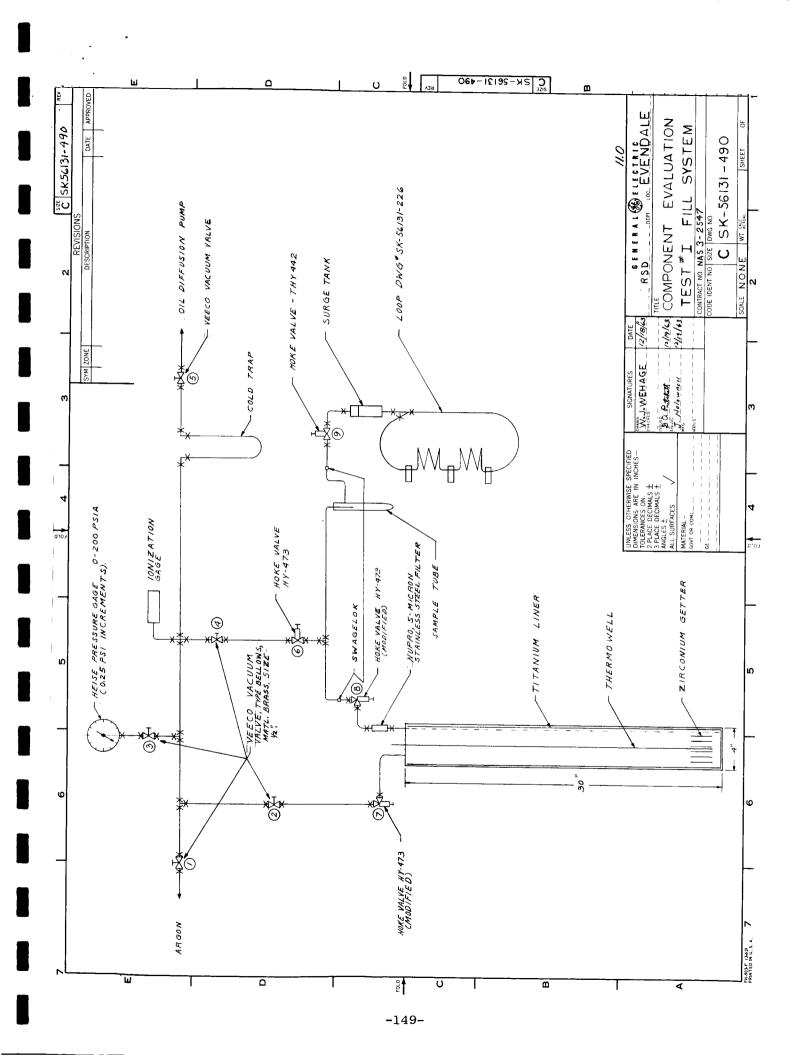




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| L. E. D  | otson and R. B. Hand   | DATE         |  |  |  |  |
| TITLE Pota   | G.E. CLASS<br>I  |              |  |  |  |  |
| ment Topi<br>Amalysis  | GOV. CLASS   |              |  |  |  |  |
| Potassium  |  | Unclassified |  |  |  |  |
|  | REPRODUCIBLE COPY FILLED AT  LIBRARY, KING OF PRUSSIA, PENNSYLVANIA  D TECH. INFO. CENTER, CINCINNATI 15, OHIO | NO. PAGES    |  |  |  |  |
| SUMMARY The work described herein was done under the sponsorship of the National Aeronautics and Space Administration, Contract NAS 3-2547, Potassium Corrosion Test Loop Development Program. Sodium and potassium were purified, analyzed and dispensed into the three test loops involved. The sodium was purified by filtration, hot trapping and vacuum distillation. Analyses of the alkali metals for oxygen content were performed by the amalgamation method, and analyses for metallic impurities were performed spectrographically. The alkali metals produced and used in the test loops contained less than 20 ppm oxygen, and the metallic impurities were at or below the detection limits. |  |              |  |  |  |  |
| Trapping   | Alkali Metal, Purification, Analys (Gettering), Vacuum Distillation,   |              |  |  |  |  |

By cutting out this rectangle and folding on the center line, the above information can be fitted into a standard card file.

| INFORMATION PREPARED FOR                                  | National Aeronautics | s and Sp | ace Administration, | , Contract NAS | 3-2547 |  |
|---|----------------------|----------|---------------------|----------------|--------|--|
| TESTS MADE BY L. E. Dotson, L. A. Paian, and J. D. Reeves |                      |          |                     |                |        |  |
| COUNTERSIGNED Dr. J.                                      | W. Semmel, Jr.       | DIV. Sp  | ace Power & Propuls | sion Section - | RSD    |  |
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